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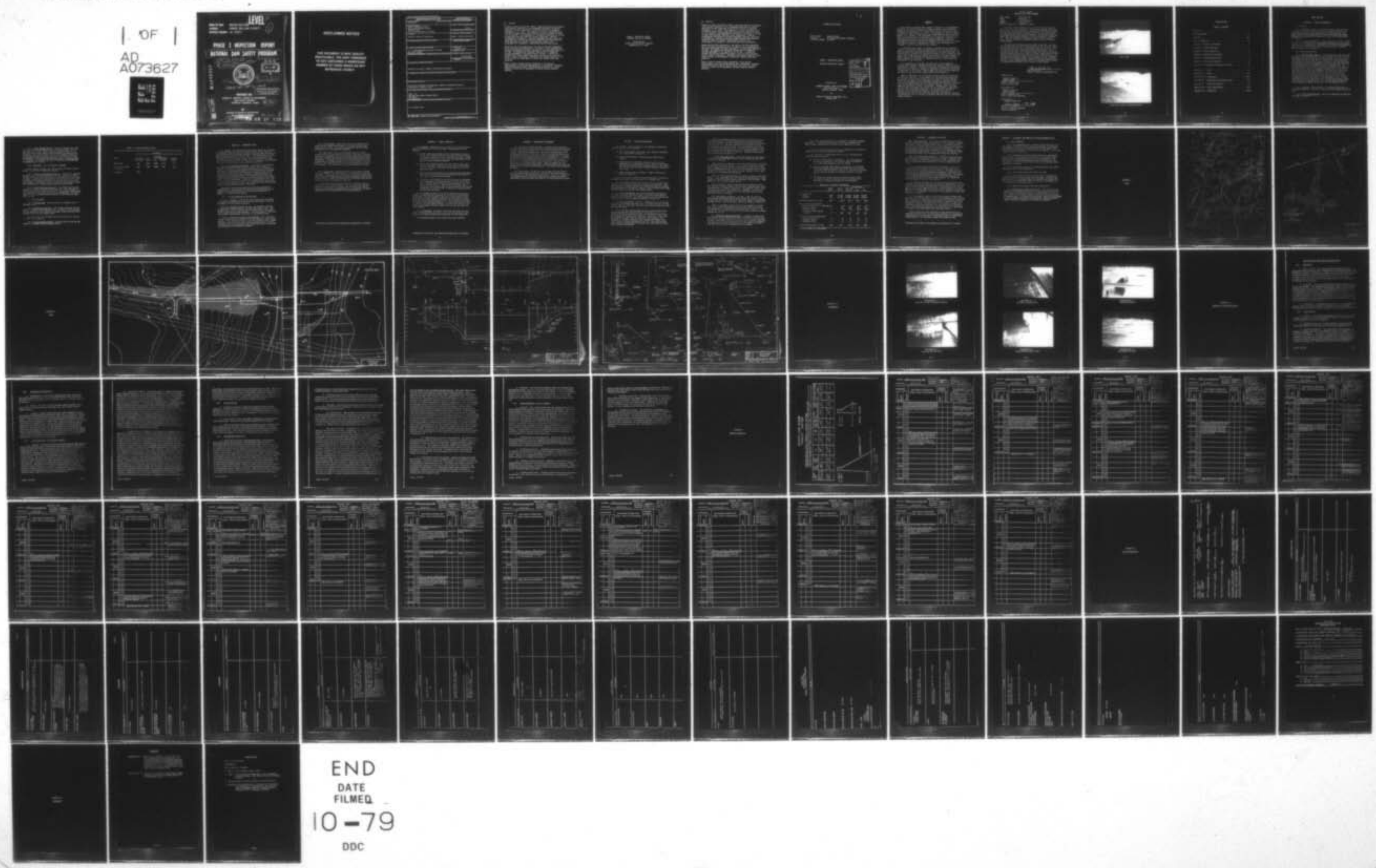

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Name Of Dam: BROAD RUN DAM
Location: PRINCE WILLIAM COUNTY
Inventory Number: VA. 15302

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PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

6

Broad Run Dam. Inventory Number: VA-15302. Prince William County. Virginia. Phase I Inspection Report.

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PREPARED FOR

NORFOLK DISTRICT CORPS OF ENGINEERS
803 FRONT STREET
NORFOLK, VIRGINIA 23510

12 86p.

BY

DEWARD M. MARTIN & ASSOCIATES
WILLIAMSBURG, VIRGINIA

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20. Abstract

Pursuant to Public Law 92-367, Phase I Inspection Reports are prepared under guidance contained in the recommended guidelines for safety inspection of dams, published by the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general conditions of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

Based upon the field conditions at the time of the field inspection and all available engineering data, the Phase I report addresses the hydraulic, hydrologic, geologic, geotechnic, and structural aspects of the dam. The engineering techniques employed give a reasonably accurate assessment of the conditions of the dam. It should be realized that certain engineering aspects cannot be fully analyzed during a Phase I inspection. Assessment and remedial measures in the report include the requirements of additional indepth study when necessary.

Phase I reports include project information of the dam and appurtenances, all existing engineering data, operational procedures, hydraulic/hydrologic data of the watershed, dam stability, visual inspection report and an assessment including required remedial measures.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

BROAD RUN DAM
PRINCE WILLIAM COUNTY, VIRGINIA
INVENTORY NO. VA 15302

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POTOMAC RIVER BASIN

Name of Dam:	Broad Run Dam
Location:	Prince William County, Virginia
Inventory Number:	VA 15302

PHASE I INSPECTION REPORT

National Dam Safety Program

Prepared for

NORFOLK DISTRICT CORPS OF ENGINEERS
803 Front Street
Norfolk, Virginia 23150

by

Deward M. Martin & Associates, Inc.
January 1979

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of the Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (flood discharges that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the design flood should not be interpreted as necessarily posing a highly inadequate condition. The design flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam	:	Broad Run Dam
State	:	Virginia
County	:	Prince William
Stream	:	Aquia Creek
Date of Inspection	:	December 6, 1979

Broad Run Dam is 1,250 feet long and 72 feet high from the top of the dam to the streambed. The concrete gravity section is 636 feet in length and the earth embankment is 614 feet in length. The ogee shaped principal spillway is 220 feet in length and 55 feet high from the crest to the streambed. The dam is located 10 miles west of Manassas, Virginia, 1 mile from Route 215 on Route 675. The lake is used as a source of water for the treatment plant, owned by the City of Manassas, which is located 300 feet below the dam.

The principal spillway will pass 100% of the PMF. The stability calculations of the gravity section of the principal spillway indicate the resultant in the middle third of the base. The Probable Maximum Flood indicated the resultant within 3 feet of the edge of the base. The original design calculations should be reviewed together with rock cores to provide a comprehensive examination of the gravity section stability under PMF conditions. A warning system procedure should be established to alert residents in case of an emergency. Annual inspections of the dam should be started. These recommendations should be completed within twelve (12) months from the date of the release of this report.

Paul Seiler, P.E.

PAUL SEILER, P.E.
Deward M. Martin & Associates, Inc.

Submitted By:

Original signed by
JAMES A. WALSH

JAMES A. WALSH, P.E.
Chief, Design Branch

Recommended By:

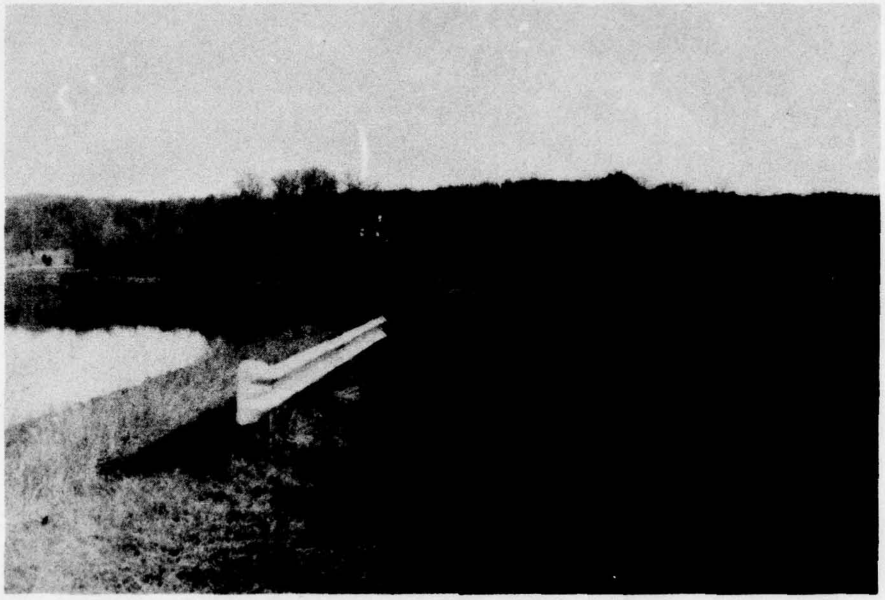
Original signed by
ZANE M. GOODWIN

ZANE M. GOODWIN, P.E.
Chief, Engineering Division

Approved By:
Original signed by:

Douglas L. Haller MAR 9 1979

DOUGLAS L. HALLER
Colonel, Corps of Engineers
District Engineer



Top of Dam

Front Face of Dam & Downstream Bridge

BROAD RUN DAM

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BROAD RUN DAM

SECTION 1. PROJECT INFORMATION

1.1 General:

1.1.1 Authority: Public Law 92-367, 8 Aug 72 authorized the Secretary of the Army, through the Corps of Engineers to initiate a national program of safety inspections of dams throughout the United States. The Norfolk District has been assigned the responsibility of supervising the inspection of dams in the Commonwealth of Virginia.

1.1.2 Purpose of Inspection: The purpose is to conduct a Phase I inspection according to the Recommended Guidelines for Safety Inspection of Dams (Appendix VI, Reference 1). The main responsibility is to expeditiously identify those dams which may be a potential hazard to human life or property.

1.2 Project Description:

1.2.1 Dam and Appurtenances: Broad Run Dam is 1,250 feet long and 55 feet high from the crest of the principal spillway at elevation 285 to the toe of the dam at elevation 230. The dam is a concrete gravity type for 636 feet of length and an earth embankment for 614 feet of length from concrete section to the right abutment. The maximum height of the embankment is 26 feet from the top of the dam at elevation 302 to existing ground at elevation 276. The principal spillway, located in the concrete portion of the dam, is an ogee section. There is a walkway along the top of the dam on both sides of the principal spillway. There are five manual controls for valves at the top of the dam to draw water from different levels for the treatment plant. There is a passageway or gallery located near the bottom of the gravity section. Riprap is showing along the lake side of the embankment. Flow from the selected level can be controlled by an electrically operated valve from inside the treatment plant. The required minimum discharge to the downstream channel is through a 48-inch diameter pipe.

1.2.2 Location: Broad Run Dam is located 10 miles west of Manassas, Virginia, 1 mile off of State Route 215, along State Route 675.

1.2.3 Size Classification: The dam is classified intermediate by height (72 feet).

1.2.4 Hazard Classification: The dam is located about 300 feet upstream from the Manassas Water Treatment Plant and there are about seven homes within 1,100 feet below the dam. It is therefore given a high hazard classification in accordance with guidelines contained in Section 2.1.2 of Recommended Guidelines for Safety Inspection of Dams, published by the Office of Chief of Engineers. The hazard classification used to categorize dams is a function of location only and is unrelated to the stability or probability of failure.

1.2.5 Ownership: City of Manassas, Virginia

1.2.6 Purpose of Dam: The dam was built to create a water supply for the City of Manassas, Virginia.

1.2.7 Design and Construction History: The dam was designed by Hayes, Seay, Mattern & Mattern of Roanoke, Virginia in 1968. Contract plans and specifications and boring logs are on file with the Owner. Construction was completed near the end of 1970. Construction photographs required by the contract are on file with the designer. According to verbal comments by the designer, there were no problems or complications during the construction.

1.2.8 Normal Operating Procedures: Dam operations are generated by the water treatment plant operators. This consists of taking water from the lake for treatment, cleaning the trash racks, and maintaining the minimum flow required downstream. The dam is observed by the treatment plant operators in the course of their work each day.

1.3 Pertinent Data:

1.3.1 Drainage Area: The dam controls a drainage area of 60 square miles.

1.3.2 Discharge at Dam Site: The maximum discharge was the result of Tropical Storm Agnes in 1972, in which a flow of 16,800 cfs was recorded at the Buckland Storm gage located upstream which measures flow from 50.5 square miles.

The capacity of the principal spillway with water at the top of the dam is 60,000 cfs.

1.3.3 Dam and Reservoir Data: Pertinent data on the dam and reservoir are shown in the following table:

Table 1.1 DAM AND RESERVOIR DATA

ITEM	Elevation Ft., msl	Area Acres	Capacity Acre Feet	Capacity Watershed Inches	Length Miles
Top of Dam	302	1100	28000	8.70	7.7
Crest of Principal Spillway	285	650	12000	3.80	5.8
Streambed	230				

(Area, Capacity and Length columns grouped under RESERVOIR)

SECTION 2. ENGINEERING DATA

2.1 Design: The preliminary water supply study, for the City of Manassas, showed the need of Broad Run Dam. Design plans and specifications for the dam were prepared by Hayes, Seay, Mattern and Mattern, and are on file with the owner. The plans show site plan, hydrology and details of sections. The specifications show logs of borings taken for design. Design calculations were not available from the owner, but are of file with the designer. The Stability check was calculated with results shown in Appendix V.

*2.1.1 Geological Investigation: A geological investigation was conducted by the design engineers, Hayes, Seay, Mattern & Mattern. A total of 27 soil tests borings and rock corings were performed. A detailed evaluation of the borings is not available. The original test borings for the dam revealed overburden soils consisting of silty clay and clayey silt, generally ranging in thickness from 2 feet to 8 feet. The upper 10 feet of the underlying bedrock was highly fractured, resulting in high water losses during drilling operations. Below the first 10 feet of rock, the rock was less fractured and small to negligible water losses were recorded during drilling. There was no mention in the geotechnical report of any pressure testing of the rock.

There were no faults encountered during the geotechnical investigation. Slickensides were found on some fractures but no evidence was detected during the geotechnical exploration to suggest substantial displacements.

2.1.2 Geologic Setting of the Dam Site:

* 2.1.2.1 Regional: The general area of the dam lies within a geologic province known as the Triassic Fault Basin. The area is underlain by the Newark Formation.

* 2.1.2.2 Specific Area of the Dam: The immediate dam area is underlain by quartz diorite, an intrusive igneous rock. The strike of the rock is generally N60°E to N80°E with a dip angle of 70 to 80 degrees to the southeast. Fracture planes in the rock are oriented approximately 90 degrees to the bedding plane.

* 2.1.3 Foundation Treatment and Conditions: The foundation of the concrete gravity portion of the dam consists of hard quartz diorite. The earthfill portion of the dam (Stations 1+00 to 8+00) contains a cut-off trench with a minimum bottom width of 10 feet. A specification on the material type within the cut-off trench was not contained in the contract documents.

*2.2 Construction: Compaction tests were reportedly performed during construction; however, records of these tests could not be located. A grouting program was also reportedly performed, but no records were available.

2.3 Operation: The City of Manassas does not employ regular operational procedure for the dam. The water treatment operator is responsible for the operational procedure involving raw water drawdown for treatment and maintaining required flow downstream. Inspection of the dam is done through observations by the water treatment operators, incidental to their daily activities. Auxiliary electrical power is provided by a gasoline driven genator. All valves can be manually operated if needed.

*2.3 Evaluation: Geotechnical data in the form of boring logs is available. No laboratory data for the soil or rock was available. In addition, no construction records for quality control of the soil compaction or foundation grouting are available. In the absence of this geotechnical data, additional data as outlined in Section 6.3 should be collected.

Engineering data for Broad Run Dam is available through either the owner or the designer. The data should be gathered together in the files of the owner and carefully kept and updated as maintenance or improvements are accomplished throughout the history of the useful life of the dam structure.

*Information provided by Law Engineering Associates of Virginia

SECTION 3. VISUAL INSPECTION

3.1 Findings: Appendix VI is a record of the field observations taken during the field inspection. Seepage was noted as follows:

1. On the right non-overflow section, there was a wet area on the wall halfway down the steps about 70 feet from end of concrete and about 25 feet from the top of dam. Other dry calcium stains are on this same wall beginning at elevation 275 and extending downward.

2. Stains were showing through the thin film of water going over the spillway. These stains are about 44 feet from the left end of the principal spillway and 10 to 15 feet below the crest.

3. The left wall has hairline cracks showing calcium deposits. The crack is located at about elevation 250 and about 10 feet left of the principal spillway.

4. The gallery has moisture on the floor and wall, extending from the bottom of the incline from the left end of the dam, along the level section of the passageway for a distance of about 60 feet. The moisture is coming from a horizontal construction joint on the downstream side of the passageway at elevation 238. A deposit of calcium covers the wet wall and floor.

*3.1.1 During the time of the site inspection no seepage or signs of instability were observed in the earth-filled portions of the dam. The left abutment consisted of hard quartz diorite with only very minor seepage occurring along the fracture plane. Since the inspection was conducted on a day following rainstorms, it could not be ascertained whether the seepage was from the pool or from the adjacent small hillside. A small rock slide was observed approximately 150 feet downstream from the dam along the left abutment.

3.2 Evaluation: The visual inspection indicated that the four items listed under seepage in paragraph 3.1 should be monitered on a scheduled basis and records kept of this inspection.

The abutments appear to be in generally good condition.

*Information provided by Law Engineering Associates of Virginia.

SECTION 4. OPERATIONAL PROCEDURES

4.1 Procedures and Maintenance: The water plant operators regulate the volume of water discharged downstream and remove debris from the trash rack periodically. No log of observations is maintained. The City of Manassas does not employ a person solely for operational procedure of the dam. The water treatment operator is responsible for the operational procedure involving water drawdown for treatment and maintaining required flow downstream. Inspection of the dam is done through observations by the water treatment operators, incidental to their daily activities. Electricity for lighting and operation of the control valve is supplied by the Prince William Electric Corporation. Auxiliary electrical power is provided by a gasoline driven generator. All valves can be manually operated.

4.2 Evaluation: The dam does not require extensive operational and maintenance procedure. Periodic inspections should be made and notes maintained on an annual basis. Any noted changes in conditions should be carefully monitored or if deemed necessary, maintenance repairs be made and noted in the next inspection report.

SECTION 5. HYDRAULICS/HYDROLOGY

5.1 Design: General hydraulic and hydrologic design data used for analysis is as follows:

a) Construction Plans from Hayes, Seay, Mattern & Mattern, dated June 1958 - partial set.

b) Study of Town Council, Manassas Water Supply Study, undated.

c) "Optimization of Raw Water Interconnection for the Washington, D.C. Metropolitan Area - Phase I Hydrologic and Hydraulic Data" by GKY & Associates, Inc. for Department of the Army, Baltimore District Corps of Engineers, July 1978.

d) Gaging Station data from USGS 1 - 6565 - Broad Run at Buckland, Virginia.

5.1.1 These data contained original hydrologic assumptions, spillway rating curve, and some details of construction.

5.2 Hydrologic Records: As mentioned in 5.1, gaging information from Broad Run at Buckland, Virginia was available. This data was used to compare theoretical hydrographs used to evaluate the performance of the system. Highest flood of record was 16,800 cfs and occured on June 21, 1972 (Agnes flood).

5.3 Flood Experience: No detailed flooding experience is available, however, the Agnes flood of 1972 was passed without damage to the structure. The maximum depth over the spillway was estimated at 6.5 feet, which corresponds to 13,300 cfs.

5.4 Flood Potential: General - Assuming the pool elevation to be at the principal spillway crest, elevation 285 msl, the PMF and the 100 year flood were developed and routed through the reservoir and spillway.

5.4.1 The PMF, Probable Maximum Flood, was developed from data in Hydrometeorological Report 33 (Reference No. 1). The Probable Maximum Precipitation (PMP) for the Broad Run Dam area is 25 inches in 24 hours for a 200 square mile area. This value was modified for the Broad Run 60 square mile drainage area inputted to the HEC-I program, Flood Hydrograph Package, which synthesized an inflow hydrograph of the PMF. The ½ PMF inflow hydrograph was constructed by reducing each calculated PMF hydrograph ordinate by one-half.

The inflow hydrographs were constructed utilizing the unit hydrograph concept. The unit hydrograph was developed using a one-hour duration of excess precipitation and Synder's parameters (Reference No. 2). The HEC-I program then distributed excess precipitation in time and amount. The distribution thus derived was modified by revising the per cent hourly distribution within the maximum 6 hour precipitation to more closely conform to that used in TP 40 for the 100 year rainfall. Results of this analysis are presented in Table 5.1.

5.5 Reservoir Regulation: Broad Run Dam has an ogee-shaped uncontrolled spillway with a crest length of 220 feet and crest elevation of 285 msl.

Other outlets are integral to the dam and located at elevation 235.0, 265.0, 255.0 and 248 msl. These are for raw water intake to the treatment plant and are controlled by a 48-inch gate valve with a maximum capacity of 90 cfs with the reservoir water surface at elevation 300. As this amount is small relative to the ogee section, it was ignored during routing.

There is also a 48-inch pipe drain used to control outlet discharge. Using discharge curve as supplied by the designer, a discharge of 340 cfs at water surface elevation, 256 was noted. This amount was also ignored during routing.

5.5.1 Reservoir storage capacity above the spillway crest was calculated using contours from USGS maps, planimetering areas, and converting to volume in acre-feet. The spillway rating curve used was that given in the design data furnished. Routing was started assuming pool elevation at the principal spillway crest and inflow equal to outflow.

5.6 Overtopping Potential: The PMF, ½ PMF and 100 year flood inflow hydrographs were routed through the reservoir using the modified Puls method option of the HEC-I computer program with storage-outflow. Results of this routing are shown in Table 5.1.

5.6.1 A tailwater rating curve was not available for this dam. The tailwater elevation observed during field observation was approximately 234 msl with an assumed flow of 210 cfs. The 210 cfs was used as the starting base flow when routing the storms through the system.

5.7 Reservoir Emptying Potential: To empty the dam, there is a 48-inch outlet pipe with an invert elevation of 236 msl and a discharge capacity of 495 cfs at normal water surface elevation, 285 msl. The outlet flow curve was developed using the designer's discharge curve to elevation 256 msl and extending it to elevation 285 msl by use of a standard orifice equation.

5.7.1 The above information was inputted to the HEC-I program, with 60 cfs inflow and a developed storage vs. outflow curve. This analysis indicated that the dam can be emptied in 24 days.

5.7.2 This 48-inch outlet pipe was in operation at the time of inspection and therefore assumed functional.

5.8 Evaluation: Summarizing Table 5.1, the following data resulted from this study:

a) Spillway design flood is 50,000 cfs. This rate gives an elevation of 300 m.s.l. and leaves 2 feet of freeboard. It is the flood originally used for design.

b) Based on the high risk category of this dam, the spillway should be capable of passing the PMF which is an inflow of 56,399 cfs. with outflow of 53,996 cfs With pool elevation at the crest of the dam, the outflow capacity is 60,000 cfs.

c) All hydrologic considerations presented in this report are based on present conditions and no allowances have been made for future development of the watershed.

TABLE 5.1 - RESERVOIR PERFORMANCE

	Normal Flow	100 Yr. Storm	Hydrograph June '72 Flood*	½ PMF	PMF
Peak Flow, cfs					
Inflow	210	15,546	17,000	28,199	56,399
Outflow	210	12,709	13,300	25,093	53,996
Maximum Elevation, ft. msl	285	291.3	291.5	294.5	300.5
Ungated Spillway (285 msl)					
Depth of flow, ft.	less than 1	6.3	6.5	9.5	15.5
Duration, hours	--	80	80	80	80
Velocity, f.p.s.	--	9.2	9.3	12.0	15.8
Percentage Peak outflow Passed	--	100	100	100	100
Non-Overflow Section (302 msl)					
Depth of flow, ft.	--	0	0	0	0
Duration, hours	--	0	0	0	0
Velocity, f.p.s.	--	0	0	0	0
Tailwater Elevation, ft. msl	234	247	247.3	252	260

* Figures shown are approximate

SECTION 6. STRUCTURAL STABILITY

*6.1 Dam Foundation: The concrete gravity portion of Broad Run Dam is founded on hard quartz diorite. The contract documents indicated a cement grouting program was to be conducted beneath the concrete grouting portion of the dam and beneath approximately 70 feet of the cut-off trench for the earth embankment. Since construction records are not available for the grouting program, an assessment cannot be made of the success of the program, other than the observation that no downstream leakage was observed.

*6.2 Earth Embankment Stability: Stability calculations are not available and can therefore, not be checked. Although there were no signs of instability, there was no soil laboratory test data or sufficient soil description to allow a rough stability check.

*6.3 Foundation Condition and Soil Stability: Due to the foundation of the concrete gravity portion of the dam being a competent rock, settlement is not a problem. Although there was a potential for leakage through the foundation, a grouting program was reportedly performed in the foundation rock. The success of the grouting program cannot be evaluated since there are no construction records for the grouting program. No leakage was observed downstream of the dam, however.

6.4 Concrete Gravity: The concrete gravity section at the principal spillway was checked for stability. When water is at the crest of the spillway, elevation 285, the resultant on the base is at the middle third point on the base. When the water is at the PMF level, elevation 300.5, the resultant is located at 3 feet back from the toe of the dam. The results of the stability analysis are shown in Appendix V.

6.5 Evaluation: There is insufficient data available with which to check the stability of the earth embankment section of the dam. Therefore, a geotechnical exploration is required to gather this required data. The exploration should consist of soil tests borings to verify the stratigraphy of the dam and to obtain undisturbed samples for laboratory strength testing and classification. After obtaining this data, the stability of the dam should be checked under both drained and undrained loading.

The evaluation of this condition is that the dam will not overturn but that review of the design assumption for leading and connection into the base rock is necessary to get a comprehensive understanding of the stability design and parameters used.

*Information provided by Law Engineering Associates of Virginia

SECTION 7. ASSESSMENT AND REMEDIAL MEASURES/RECOMMENDATIONS

7.1 Dam Assessment:

7.1.1 The engineering data available through the owner are site plans, section of the dam and specifications. The specifications have boring logs of holes drilled for the design. The plans and specifications were professionally prepared. Design calculations were not available.

7.1.2 The dam has no obvious misalignments or settlements that could be noted from visual inspection. The gallery shows seepage and calcium deposits on the wall with moisture on the wall and floor, which has apparently been in progress for several years. There are also seepage stains on the abutment walls along the joint lines.

7.1.3 Monitoring records of the observations of the condition of the dam are not maintained.

7.1.4 The spillway will pass 100% of the PMF.

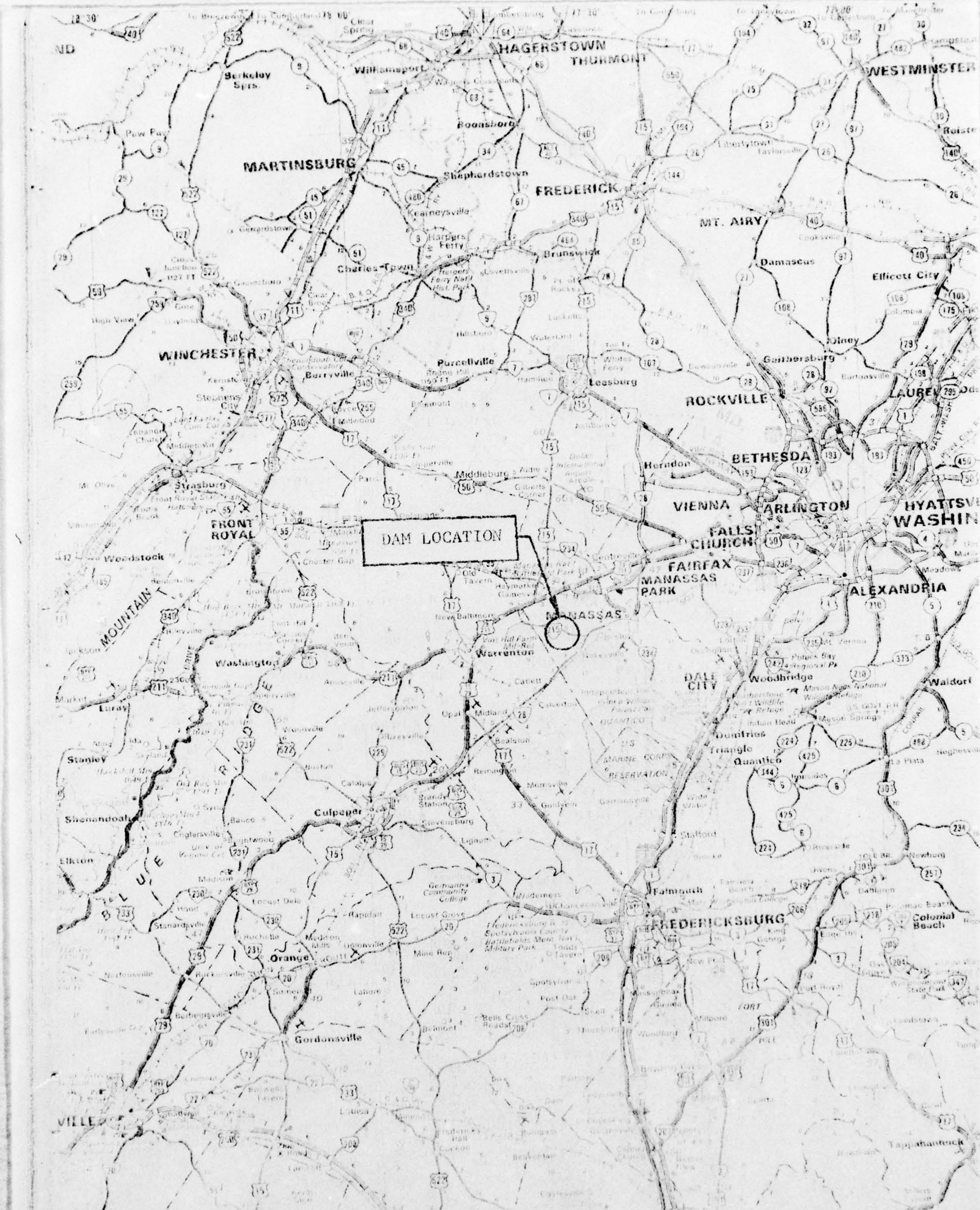
7.1.5 The stability of the gravity section is within the criteria for water at the crest of the spillway. However, with the water level of elevation 300.5 for the PMF, the results of the stability analysis shows 16% of the base in conpression and a sliding factor of safety of 6.0.

7.1.6 There is no warning procedure established.

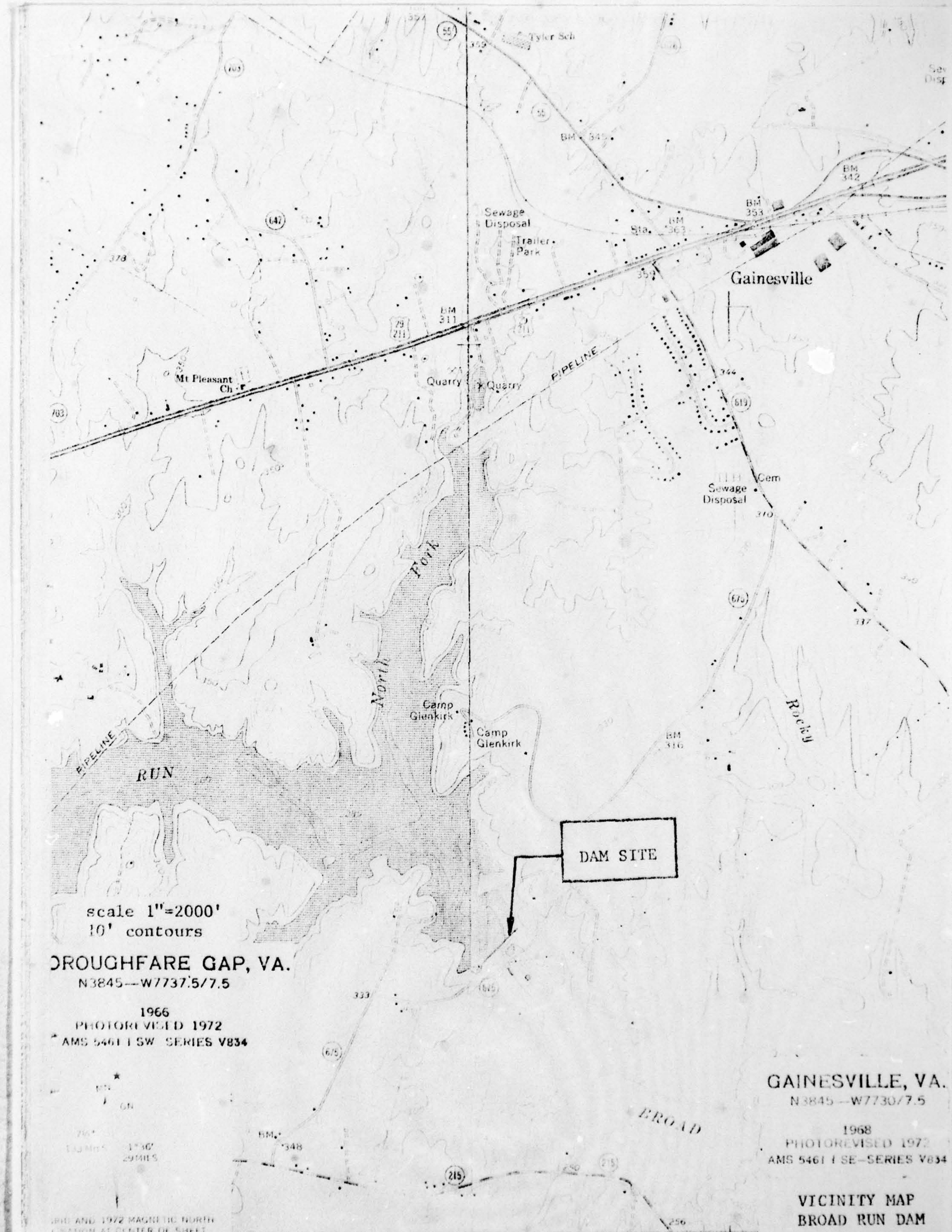
7.2 Remedial Measures/Recommendations: The stability and geological information should be checked for loadings with water levels above the spillway crest to the PMF elevation of 300.5. The seepage in the gallery should be monitered and records kept of observations. A warning system procedure should be established to alert residents in case of an emergency. Annyal inspection reports should be prepared by a professional engineer.

APPENDIX I

MAPS



REGIONAL MAP
BROAD RUN DAM



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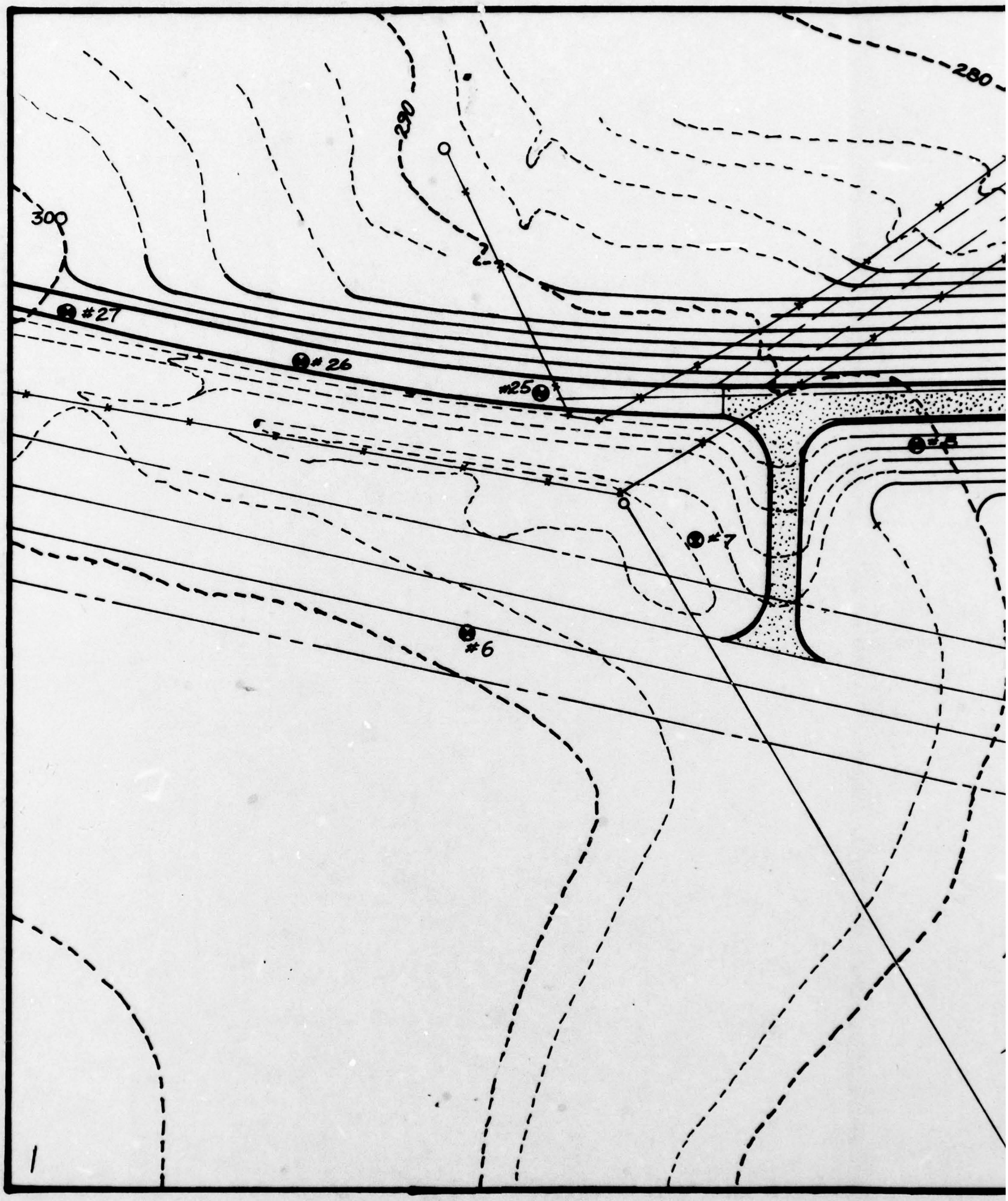
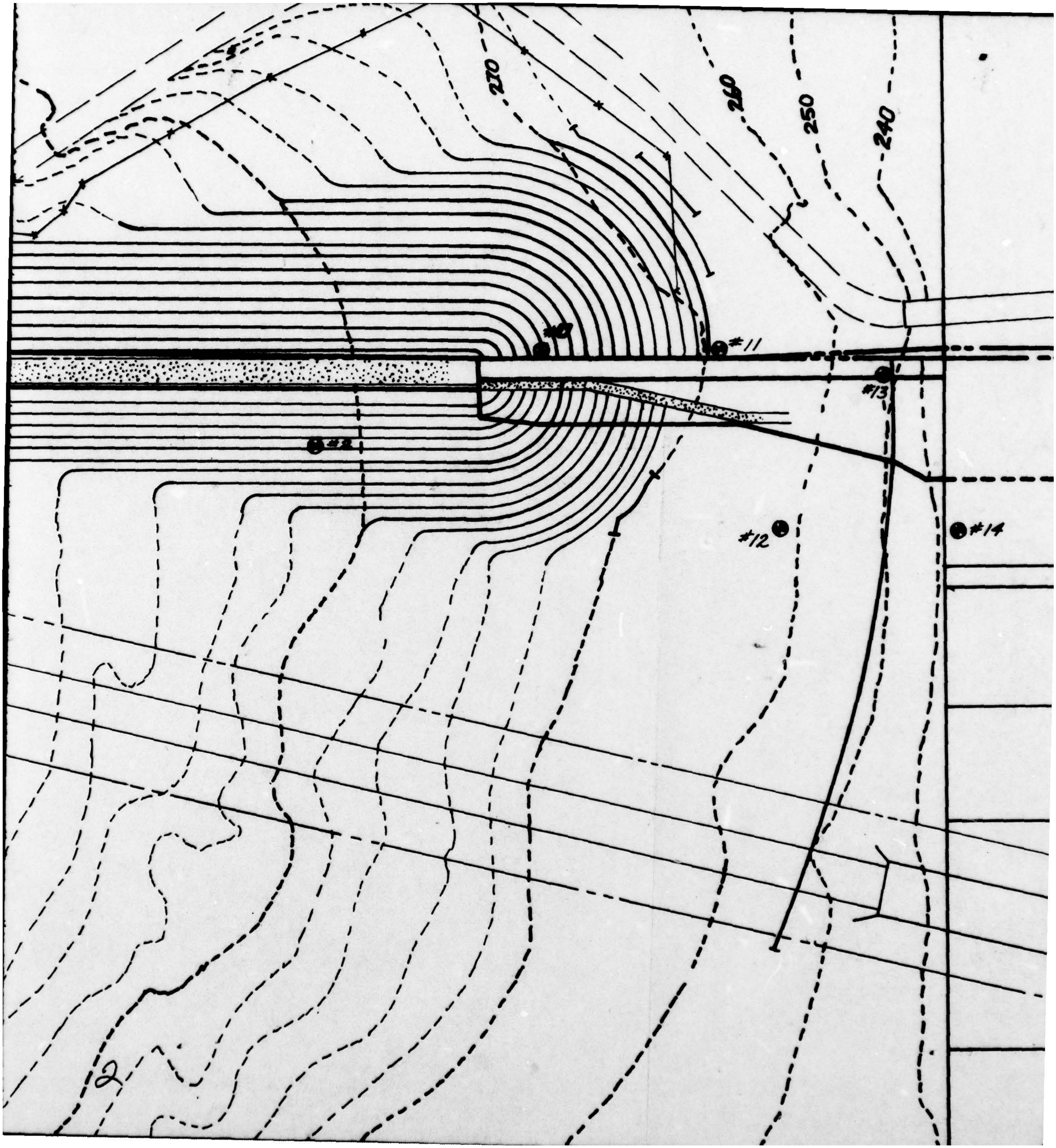
Rocky
RUN
BROAD
DAM SITE
scale 1"=2000'
10' contours
OROUGHFARE GAP, VA.
N3845—W7737.5/7.5
1966
PHOTOREVISED 1972
AMS 5461 I SW SERIES V834
GAINESVILLE, VA.
N3845—W7730/7.5
1968
PHOTOREVISED 1972
AMS 5461 I SE-SERIES V834
VICINITY MAP
BROAD RUN DAM

APPENDIX II

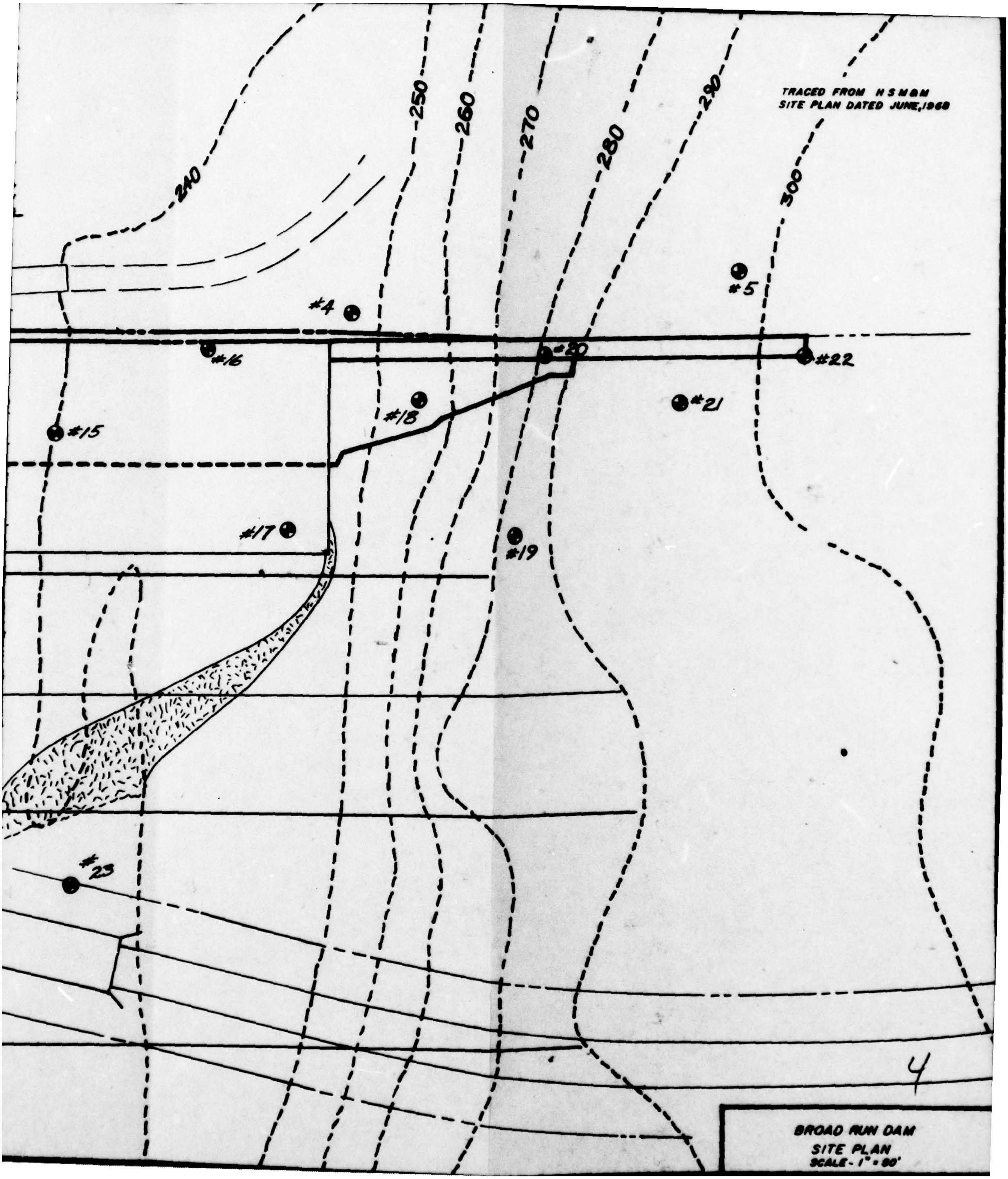
PLANS

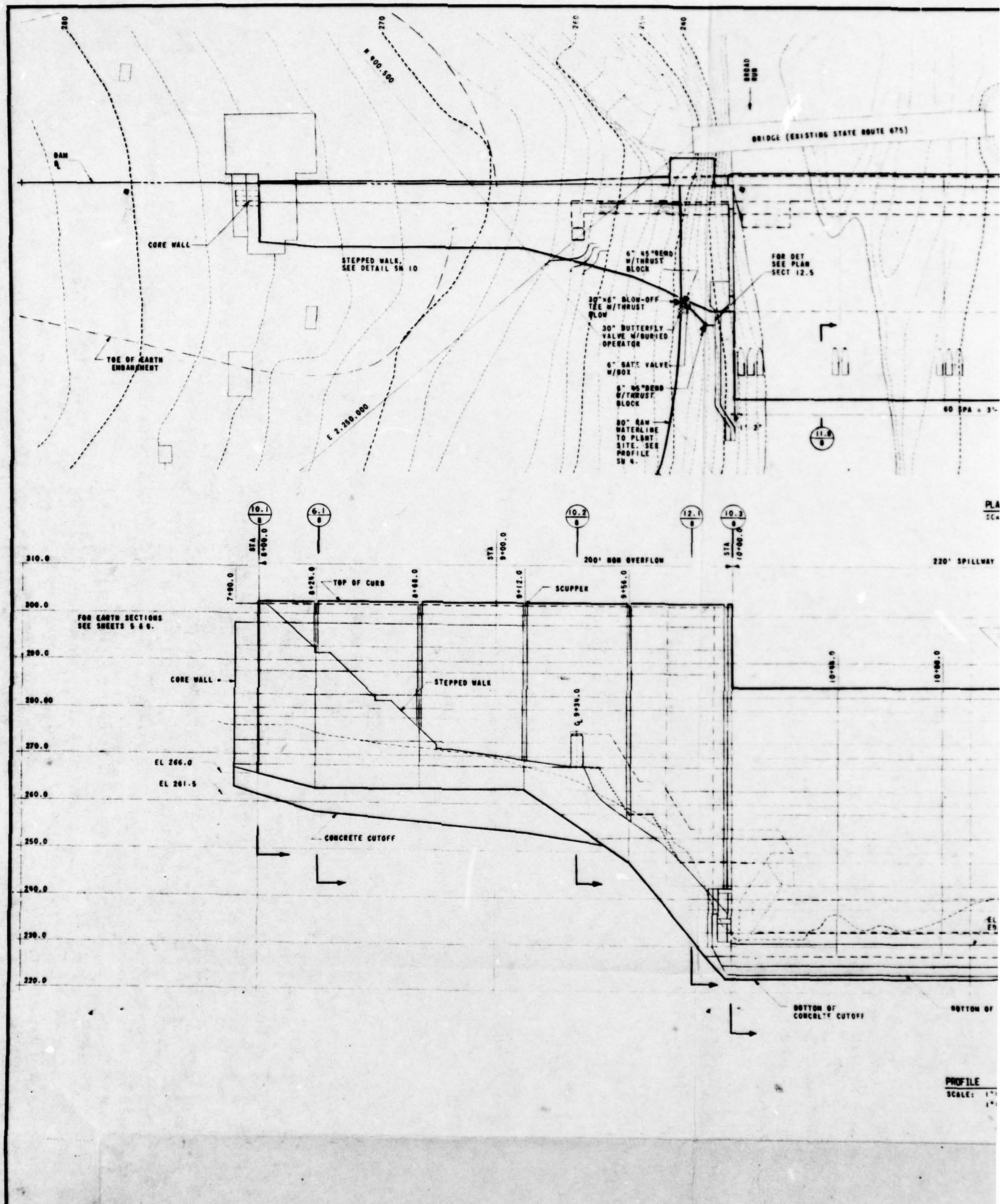


280
290
300
#27
#26
#25
#7
#6
1



270
260
250
240
#11
#13
#12
#14
2


TRACED FROM H S M & M
SITE PLAN DATED JUNE, 1968
240
250
260
270
280
290
300
#4
#5
#15
#16
#17
#18
#19
#20
#21
#22
#23
4
BROAD RUN DAM
SITE PLAN
SCALE - 1" = 80'



BROAD RUN
BRIDGE (EXISTING STATE ROUTE 675)
DAM ℄
N 400,500
E 2,250,000
CORE WALL
STEPPED WALK, SEE DETAIL SH 10
TOE OF EARTH EMBANKMENT
6" 45° BEND W/THRUST BLOCK
30"x6" BLOW-OFF TEE W/THRUST BLOCK
30" BUTTERFLY VALVE W/BURIED OPERATOR
6" GATE VALVE W/BOX
6" 45° BEND W/THRUST BLOCK
30" RAW WATERLINE TO PLANT SITE. SEE PROFILE SH 4.
FOR DET SEE PLAN SECT 12.5
60 SPA
PLA
310.0
300.0
290.0
280.00
270.0
260.0
250.0
240.0
230.0
220.0
STA 8+00.0
STA 9+00.0
STA 10+00.0
7+90.0
8+24.0
8+68.0
9+12.0
9+56.0
9+38.0
10+48.0
10+98.0
TOP OF CURB
SCUPPER
200' NON OVERFLOW
220' SPILLWAY
FOR EARTH SECTIONS SEE SHEETS 5 & 6.
CORE WALL
STEPPED WALK
EL 266.0
EL 261.5
CONCRETE CUTOFF
BOTTOM OF CONCRETE CUTOFF
BOTTOM OF
PROFILE
SCALE:

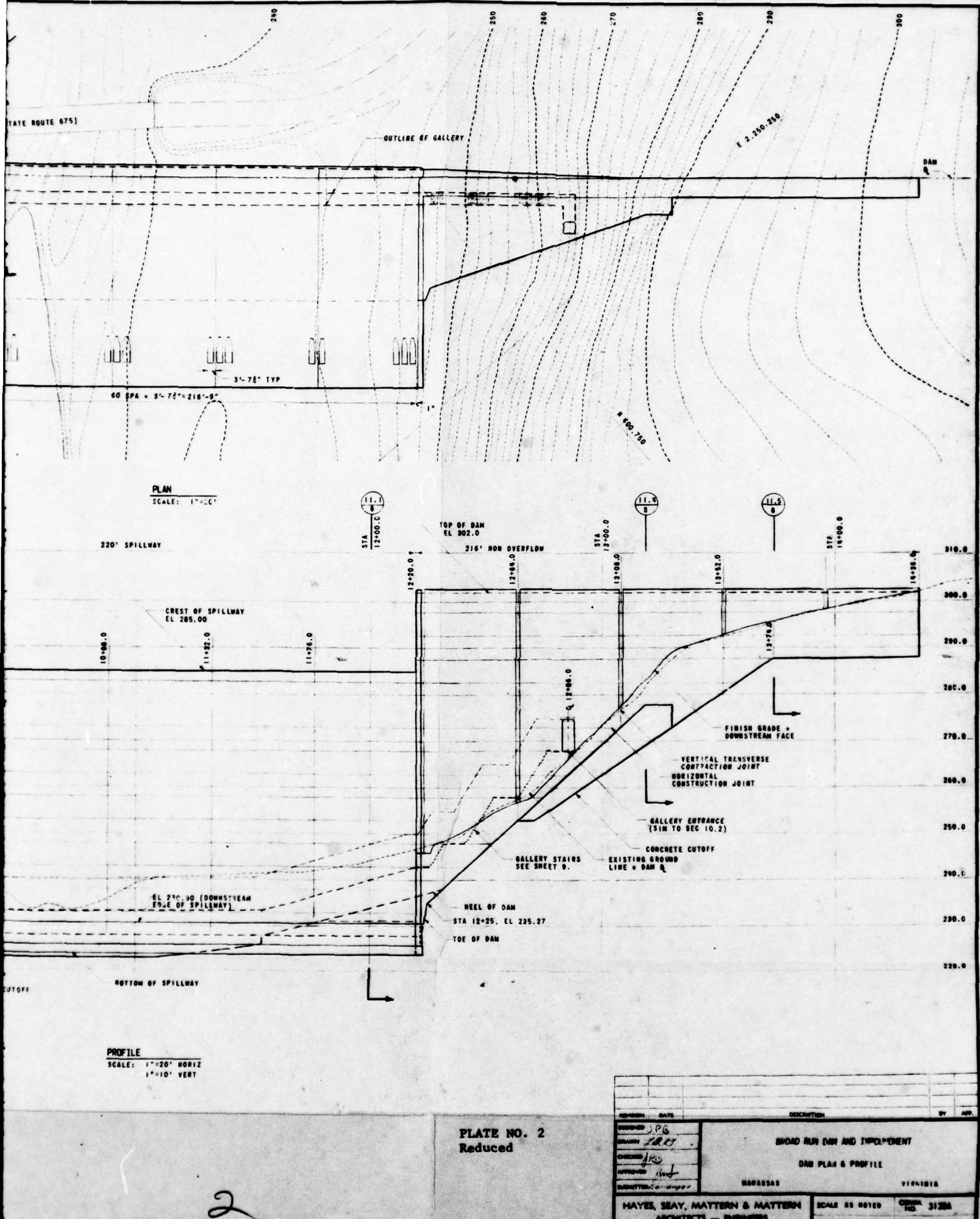
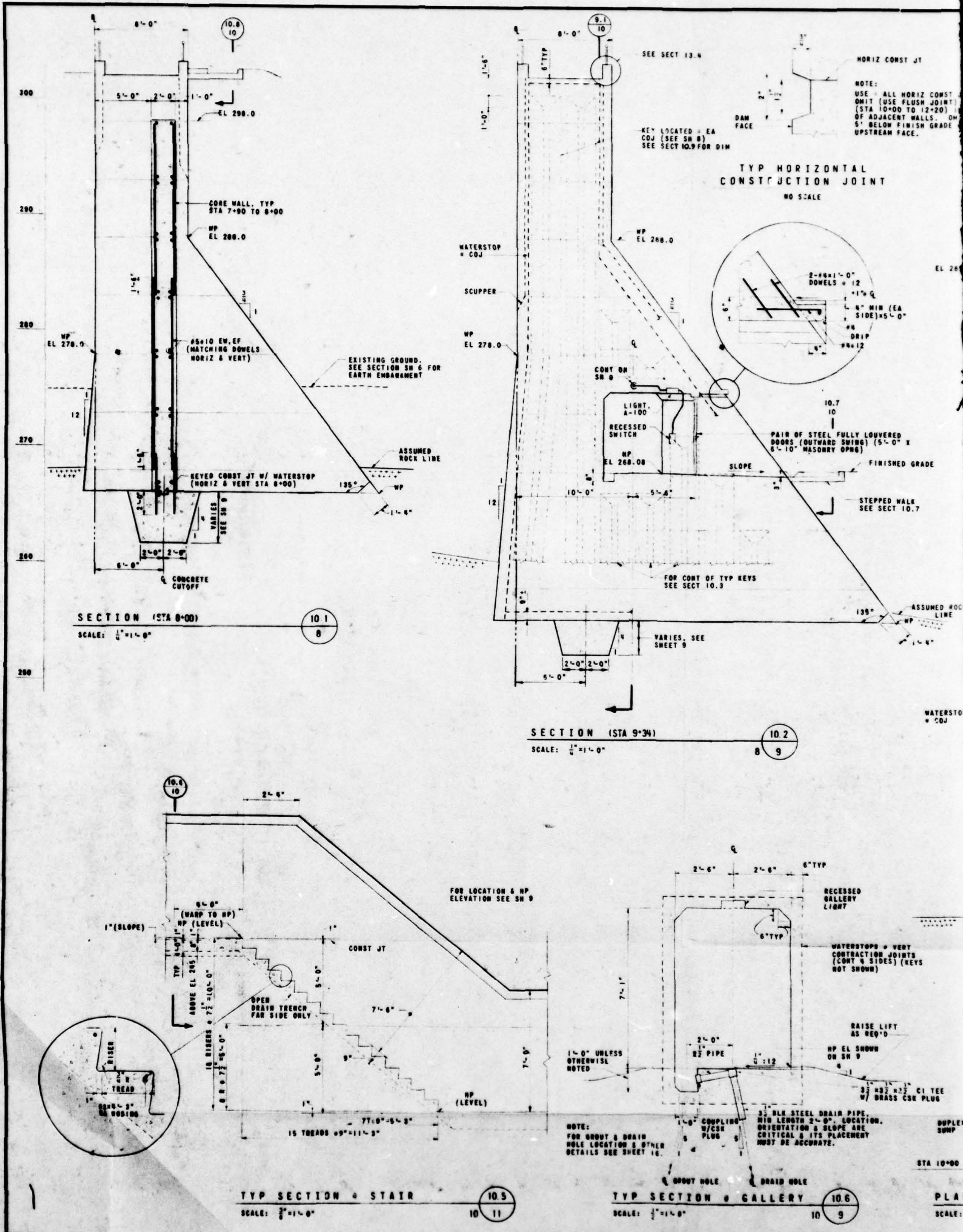
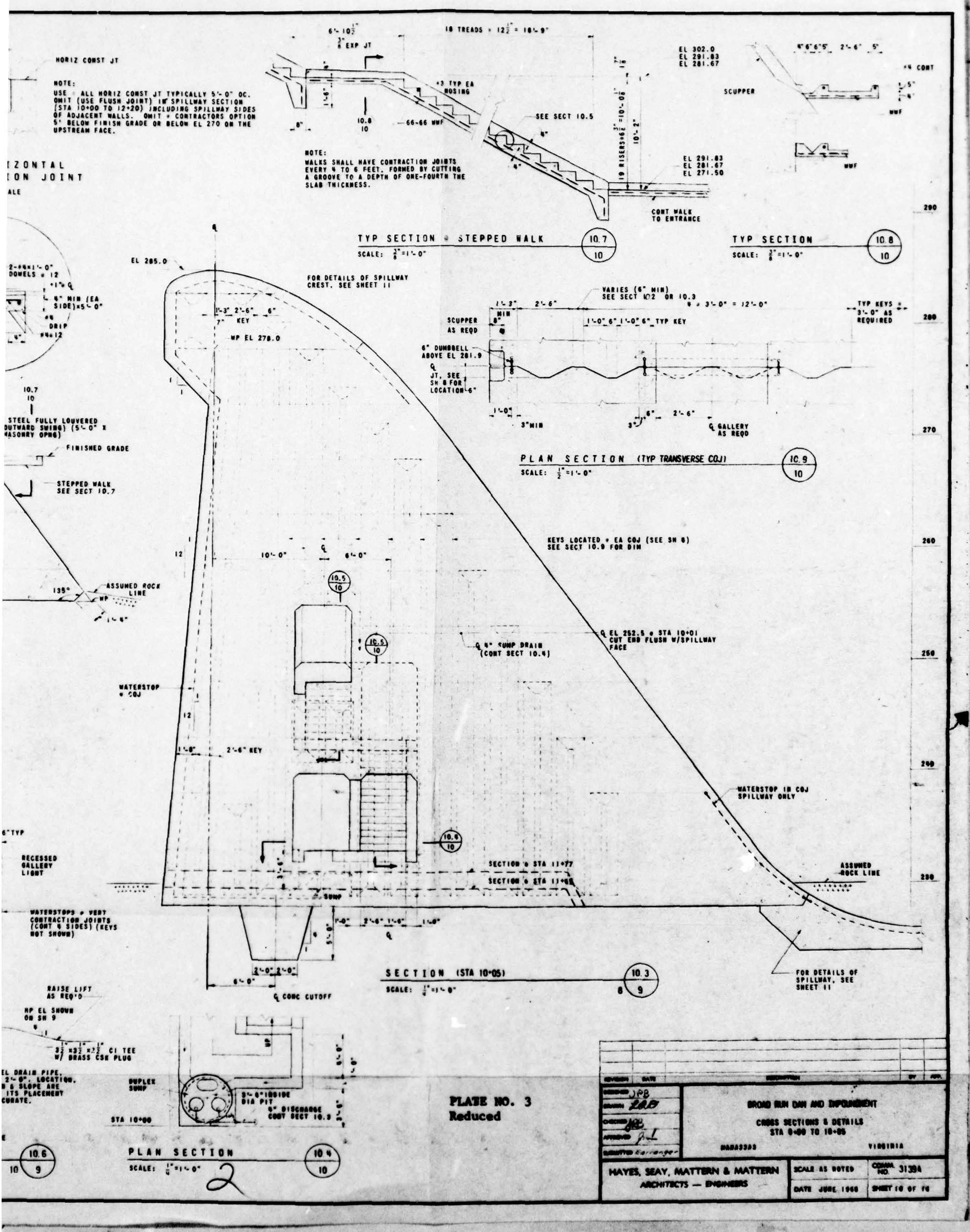


PLATE NO. 2
Reduced

2



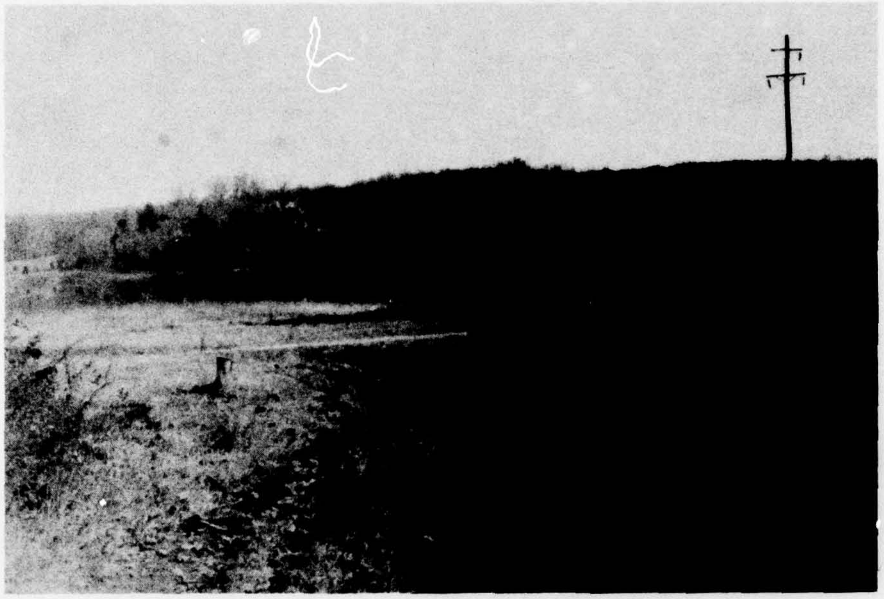
SECTION (STA 8+00)
SCALE: 1/4"=1'-0"
10.1
8
CORE WALL, TYP STA 7+90 TO 8+00
EL 298.0
HP EL 288.0
HP EL 278.0
#5@10 EW,EF (MATCHING DOWELS HORIZ & VERT)
EXISTING GROUND. SEE SECTION SH 6 FOR EARTH EMBANKMENT
ASSUMED ROCK LINE
KEYED CONST JT W/ WATERSTOP (HORIZ & VERT STA 8+00)
CONCRETE CUTOFF
VARIES SEE SH 8
SECTION (STA 9+34)
SCALE: 1/4"=1'-0"
10.2
8
9
SEE SECT 13.4
KEY LOCATED @ EA COJ (SEE SH 8) SEE SECT 10.9 FOR DIM
WATERSTOP @ COJ
SCUPPER
HP EL 288.0
HP EL 278.0
CONT ON SH 9
LIGHT, A-100
RECESSED SWITCH
HP EL 268.08
PAIR OF STEEL FULLY LOUVERED DOORS (OUTWARD SWING) (5'-0" X 6'-10" MASONRY OPNG)
SLOPE
FINISHED GRADE
STEPPED WALK SEE SECT 10.7
FOR CONT OF TYP KEYS SEE SECT 10.3
ASSUMED ROCK LINE
VARIES, SEE SHEET 9
2-#4x1'-0" DOWELS @ 12
DRIP
TYP HORIZONTAL CONSTRUCTION JOINT
NO SCALE
HORIZ CONST JT
DAM FACE
NOTE:
USE @ ALL HORIZ CONST JT. OMIT (USE FLUSH JOINT) (STA 10+00 TO 12+20) OF ADJACENT WALLS. 5' BELOW FINISH GRADE UPSTREAM FACE.
TYP SECTION @ STAIR
SCALE: 3/8"=1'-0"
10.5
10
11
FOR LOCATION & HP ELEVATION SEE SH 9
(WARP TO HP)
HP (LEVEL)
1"(SLOPE)
CONST JT
OPEN DRAIN TRENCH FAR SIDE ONLY
RISER
TREAD
15 TREADS @9"=11'-3"
HP (LEVEL)
TYP SECTION @ GALLERY
SCALE: 1/2"=1'-0"
10.6
10
9
RECESSED GALLERY LIGHT
6"TYP
WATERSTOPS @ VERT CONTRACTION JOINTS (CONT 4 SIDES) (KEYS NOT SHOWN)
RAISE LIFT AS REQ'D
HP EL SHOWN ON SH 9
1'-0" UNLESS OTHERWISE NOTED
2 1/2" PIPE
W/ BRASS CSK PLUG
COUPLING W/CSK PLUG
3 1/2" BLK STEEL DRAIN PIPE. MIN LENGTH 2'-0". LOCATION, ORIENTATION & SLOPE ARE CRITICAL & ITS PLACEMENT MUST BE ACCURATE.
NOTE:
FOR GROUT & DRAIN HOLE LOCATION & OTHER DETAILS SEE SHEET 16.
GROUT HOLE
DRAIN HOLE
DUPLEX SUMP
STA 10+00
PLAN
SCALE:



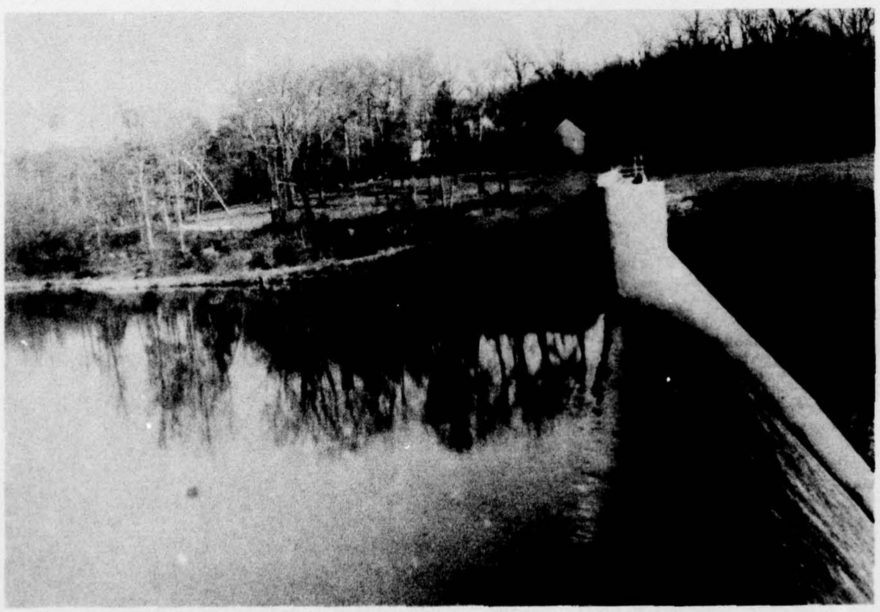
HORIZ CONST JT
NOTE:
USE ALL HORIZ CONST JT TYPICALLY 5'-0" OC. OMIT (USE FLUSH JOINT) IN SPILLWAY SECTION (STA 10+00 TO 12+20) INCLUDING SPILLWAY SIDES OF ADJACENT WALLS. OMIT CONTRACTORS OPTION 5' BELOW FINISH GRADE OR BELOW EL 270 ON THE UPSTREAM FACE.
18 TREADS @ 12½" = 18'-9"
⅜" EXP JT
SEE SECT 10.5
NOTE:
WALKS SHALL HAVE CONTRACTION JOINTS EVERY 4 TO 6 FEET, FORMED BY CUTTING A GROOVE TO A DEPTH OF ONE-FOURTH THE SLAB THICKNESS.
EL 302.0
EL 291.83
EL 281.67
SCUPPER
EL 291.83
EL 281.67
EL 271.50
CONT WALK TO ENTRANCE
TYP SECTION @ STEPPED WALK
SCALE: ⅜"=1'-0"
10.7
10
TYP SECTION
SCALE: ⅜"=1'-0"
10.8
10
EL 285.0
FOR DETAILS OF SPILLWAY CREST, SEE SHEET 11
VARIES (6" MIN) SEE SECT 10.2 OR 10.3
4 @ 3'-0" = 12'-0"
TYP KEYS @ 3'-0" AS REQUIRED
SCUPPER AS REQD
6" DUMBBELL ABOVE EL 281.9
JT, SEE SH 8 FOR LOCATION
GALLERY AS REQD
PLAN SECTION (TYP TRANSVERSE COJ)
SCALE: ½"=1'-0"
10.9
10
STEEL FULLY LOUVERED OUTWARD SWING) (5'-0" X MASONRY OPNG)
FINISHED GRADE
STEPPED WALK SEE SECT 10.7
KEYS LOCATED @ EA COJ (SEE SH 8) SEE SECT 10.9 FOR DIM
ASSUMED ROCK LINE
EL 252.5 @ STA 10+01 CUT END FLUSH W/SPILLWAY FACE
4" SUMP DRAIN (CONT SECT 10.4)
WATERSTOP @ COJ
2'-6" KEY
WATERSTOP IN COJ SPILLWAY ONLY
RECESSED GALLERY LIGHT
SECTION @ STA 11+77
SECTION @ STA 11+68
ASSUMED ROCK LINE
WATERSTOPS @ VERT CONTRACTION JOINTS (CONT 4 SIDES) (KEYS NOT SHOWN)
SECTION (STA 10+05)
SCALE: ¼"=1'-0"
10.3
8 9
FOR DETAILS OF SPILLWAY, SEE SHEET 11
RAISE LIFT AS REQ'D
NP EL SHOWN ON SH 9
CONC CUTOFF
DUPLEX SUMP
3'-0" INSIDE DIA PIT
6" DISCHARGE CONT SECT 10.3
STA 10+00
PLAN SECTION
SCALE: ¼"=1'-0"
10.6
9
10.4
10
PLATE NO. 3
Reduced
BROAD RUN DAM AND IMPOUNDMENT
CROSS SECTIONS & DETAILS
STA 9+80 TO 10+05
MANASSAS
VIRGINIA
HAYES, SEAY, MATTERN & MATTERN
ARCHITECTS — ENGINEERS
SCALE AS NOTED
DATE JUNE 1968
COMM NO. 31394
SHEET 10 OF 16
2

APPENDIX III

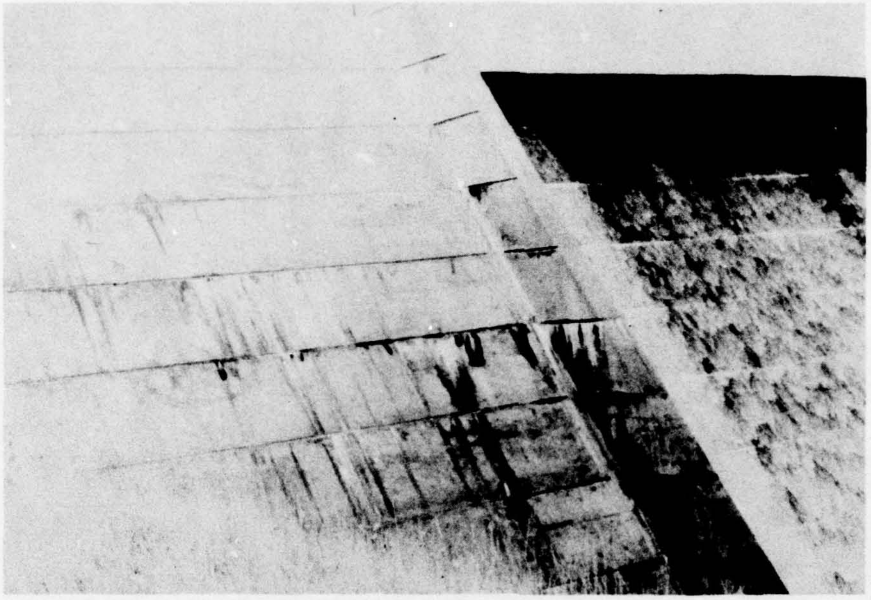
PHOTOGRAPHS



PHOTOGRAPH NO. 1
Back Face of Dam & Emergency Spillway



PHOTOGRAPH NO. 2
Principal Spillway Crest



PHOTOGRAPH NO. 3
Spillway & adjacent Wall

PHOTOGRAPH NO. 4
Riprap Upstream Face of Dam

PHOTOGRAPH NO. 5
Downstream Channel

PHOTOGRAPH NO. 6
Waterworks below Dam

APPENDIX IV

GEOLOGICAL INVESTIGATION DATA

FOUNDATION DRILLING AND GROUTING

7-01 GENERAL:

a. Scope of work: The work includes drilling grout holes, exploratory holes and drain holes; installing and making grout connections; furnishing, handling, transporting, storing, mixing and injecting the grout materials; patching the finished grout holes; care and disposal of drill cuttings, waste water and waste grout; clean-up of the areas upon completion of the work and all such other operations as are incidental to the drilling and the grouting.

b. Program: The work consists of the construction of a grout curtain as indicated. The approximate locations, limits, and details are indicated on the contract drawings. The program shown on the drawings and described herein is tentative and is presented for the purpose of canvassing bids. The amount of drilling and grouting which actually will be required is unknown and will be governed by conditions encountered as the work progresses. Any increase or decrease of the quantities shown will be computed at the applicable unit prices bid which shall be the basis for adjustment of the contract price.

c. Procedures: Grouting mixes, pressures, the pumping rate and the sequence in which the holes are drilled and grouted will be determined in the field and shall be as directed by the Architect-Engineer.

7-02 EQUIPMENT:

a. General: All drilling and grouting equipment used shall be of a type, capacity and mechanical condition suitable for doing the work as determined by the Architect-Engineer.

b. Drilling equipment: Standard drilling equipment of the rotary type shall be used to perform the drilling as specified herein.

c. Grouting equipment: The grout plant shall be capable of supplying, mixing, stirring and pumping the grout to the satisfaction of the Architect-Engineer. The plant shall be capable of injecting grout at a pressure up to 100 psi. It shall be maintained in first-class operating condition at all times and any grout hole that is lost or damaged due to mechanical failure of equipment or inadequacy of grout supply shall be replaced by another hole, drilled by the Contractor at his expense.

7-03 GROUTING MATERIALS:

a. Composition: Grout will be composed of water and cement. The grout mixes will be specified by the Architect-Engineer and will be varied to meet the characteristics of each hole as determined by conditions encountered.

b. Water: The water used in the grout shall be fresh, clean, and free from injurious amounts of sewage, oil, acid, alkali, salts or organic matter.

c. Cement: Cement used in the grout shall conform to the requirements of Federal Specification SS-C-192g, Type I or Type II. Storage of cement shall be in accordance with the requirements of Section "Concrete Work". The use of bulk cement will be permitted provided the Contractor employs methods of handling, transporting, and storage that are satisfactory to the Architect-Engineer; otherwise, only cement furnished in cloth or paper bags will be acceptable. A sufficient quantity of cement shall be stored at or near the site to insure that grouting operations will not be delayed by shortage of cement. In the event the cement is found to contain lumps or foreign matter of any nature and in amounts which, in the opinion of the Architect-Engineer, may be deleterious to the grouting operations, screening through a standard 100 mesh screen may be required. No payment will be made for such screening.

7-04 EXPLORATORY AND GROUT HOLES:

a. General: All holes drilled and grouted from the gallery shall be at 10-foot intervals and are referred to as primary holes. Secondary holes are within the area covered by the concrete portion of the dam exclusive of the galleried area. Tertiary holes embrace the area of the earthfill embankment. Quatenery holes, the last to be drilled and grouted, are located in the east abutment area. Hole groupings are to be drilled in the sequence outlined above. The number of grout holes shall be increased, progressively, by the split spacing method as deemed necessary by the Architect-Engineer until the amount of grout taken indicates that the foundation is tight. The use of grease, "rod dope", or other lubricant on rotary drill rods will not be permitted. Each hole drilled shall be protected from clogging or obstructions by means of a cap or other suitable device; any hole that becomes clogged or obstructed before completion of operations shall be cleaned out in a manner satisfactory to the Architect-Engineer or another hole provided by and at the expense of the Contractor.

b. Grout hole drilling: Grout holes shall be drilled with standard rotary drilling equipment. No core recovery will be required and the type bit used shall be optional with the Contractor. The diameter of hole shall be not less than 1-1/2 inches at the point of maximum penetration. No grout hole will be drilled at an angle greater than 45 degrees measured from the vertical nor to a depth greater than 85 feet measured from the gallery or the indicated construction lift. If, as the work progresses, it is determined that holes to depths greater than indicated in the bid schedule are necessary, drilling to such greater depth will be ordered in writing, and the drilling to depths in excess of 85 feet will be paid for at a negotiated unit price. Whenever a void or artesian flow is encountered, the drilling operations shall be stopped and the hole grouted before drilling operations are resumed in such hole. The grout so injected remaining in a partially completed hole shall be removed therefrom by washing or other methods before it has set sufficiently to require redrilling. Redrilling required because of the Contractor's failure to clean out a hole before the grout has set shall be performed at the Contractor's expense except that where the grout has been allowed to set by direction of the Architect-Engineer, the redrilling will be paid for at the rate of 50 percent of the schedule price for drilling the grout hole.

c. Exploratory hole drilling: The Contractor shall perform such exploratory drilling as may be required to determine the condition of the rock prior to grouting or the effectiveness of the grouting operations after grouting. All exploratory drilling shall be performed with rotary drilling equipment using coring type bits. Since the maximum recovery of unpredictable soft or friable materials is of prime importance, the Contractor shall, when such materials are encountered or when directed, use a standard ball bearing, swivel type, double tube core barrel equipped with diamond set core bits and standard core lifters, similar in construction and equal in performance to the Sprague and Henwood "M" series. The amount of, and the requirement for, exploratory drilling will be as directed. The NX holes may be required to be drilled to varying depths, with a maximum depth of 125 feet. Special care shall be exercised to obtain cores in good condition. The Contractor shall keep, in a manner satisfactory to the Architect-Engineer, and furnish to the Architect-Engineer an accurate driller's log of all exploratory holes drilled. The log shall include a non-technical description of all materials encountered in the drilling, their location in the holes and the location of special features such as seams, open cracks, soft or broken rock, points where abnormal loss or gain of drill water occurred, and any other items of interest in connection with the purpose for which the exploratory drilling is required. Wooden core boxes will be furnished by the Contractor, and the Contractor shall place the cores in the boxes in the correct sequence, separated accurately by wooden blocks, according to the measured distances

in the holes. No box shall contain cores from more than one hole. The covers shall be fastened securely to the core boxes and the boxes shall be delivered to the office of the Architect-Engineer in Roanoke, Virginia. Exploratory holes may be grouted under pressure, if conditions so indicate, but in all such cases the holes shall be grouted to full depth in one operation and the Contractor will not be required to remove the grout from any part of the hole.

7-05 DRAIN HOLES:

a. Drain holes shall be drilled with standard rotary drilling equipment. Drilling of drain holes shall not commence until all grouting operations have been completed. No core recovery will be required and the type bit used shall be optional with the Contractor. The diameter of the hole shall be not less than 3 inches.

b. The location, depth, and angle of drain holes are shown on the contract drawings. All drain holes shall be drilled from the gallery.

c. Black steel pipe employed for guiding drain hole drilling shall be carefully placed at the proper location and slope required. The pipe shall be suitably tied or braced to prevent movement during pouring of the surrounding concrete. Care shall be exercised to see that plugs required in the drain hole piping are readily accessible and easily removable.

7-06 PRESSURE GROUTING:

a. Washing and pressure testing grout holes: Immediately before the pressure grouting of any hole is begun, the hole shall be thoroughly washed under pressure and pressure tested. All intersected rock seams and crevices containing clay or other washable materials shall be washed with water and air under pressure to remove as much of these materials as possible. If practicable, as determined by the Architect-Engineer, such material shall be ejected from one or more holes by introducing water and air under pressure into an adjacent hole. In no case shall such pressure exceed the maximum grouting pressure as directed. All grout holes shall be tested with clean water under continuous pressure up to the required grouting pressure as directed. All holes sufficiently tight to build up the maximum required pressure shall be washed at such pressure and the washing shall continue as long as there is any increase in the rate at which water is taken, such increase indicating that fractures are being opened by the washing operation. Open holes in which no pressure can be built up shall be washed for a period of five minutes, with the pump operating at full capacity, or for such period of time as fracture-filling

is being removed, as evidenced by the escape of muddy water through surface openings or other grout holes.

b. Grouting pressures to be used in the work will vary with conditions encountered in the respective holes and pressures used shall be as directed. It is anticipated that pressures will range from 0 psi to 80 psi, but in no event will pressures in excess of 100 psi be required.

c. Grouting: All pressure grouting operations shall be performed in the presence of the Architect-Engineer, and shall be in accordance with the following general procedures.

(1) Grout mixes: Mixes shall be in the proportions directed by the Architect-Engineer who will, from time to time, direct changes to suit the conditions found to exist in the particular grout hole. The water-cement ratio by volume will be varied to meet the characteristics of each hole as revealed by the grouting operation and will range between 3.0 and 0.6; the greater part of the grout probably being placed at a ratio of about 1.0. Grout shall consist of portland cement and water.

(2) Grout injection: Grouting connections shall be packers or nipples at the Contractor's option. In general, if pressure tests indicate a tight hole, grouting shall be started with a thin mix. If an open hole condition exists, as determined by loss of drill water or inability to build up pressure during washing operations, then grouting shall be started with a thicker mix and with the grout pump operating as nearly as practicable at constant speed at all times; the ratio will be decreased, if necessary, until the required pressure has been reached. When the pressure tends to rise too high, the water-cement ratio shall be increased as may be required to produce the desired results. If necessary to relieve premature stoppage, periodic applications of water under pressure shall be made. Under no conditions shall the pressure or rate of pumping be increased suddenly as either may produce a water-hammer effect which may promote stoppage. The grouting of any hole shall not be considered complete until that hole refuses to take any grout whatever at three-fourths of the maximum pressure required for the respective hole. Should grout leaks develop, the Contractor shall calk such leaks when and as directed, the cost thereof being included in the contract price. In the event surface leaks or "break-outs" occur that cannot be effectively stopped by calking, the hole shall be grouted by the "packer grouting" method described herein. The hole and leaking fissure shall be filled with thick grout, the pumping discontinued and the grout allowed to set sufficiently to require drilling to clean the hole. The hole shall then be drilled to the next depth and washed and cleaned in the normal manner. A packer shall then be inserted in the hole and seated

near the bottom of the previously grouted section. The grout shall then be injected into the lower portion of the hole through the packer. After grouting to the final depth the packer shall be withdrawn and full pressure applied to the pipe connection located at the collar of the hole. The packer used shall be a type approved by the Architect-Engineer which shall provide a positive seal against the bypass of grout. If, due to size and continuity of fracture, it is found impossible to reach the required pressure after pumping a reasonable volume of grout at the minimum workable water-cement ratio, the speed of the pumping shall be reduced or pumping shall be stopped temporarily and intermittent grouting shall be performed, allowing sufficient time between grout injections for the grout to stiffen. Following such reduction in pumping speed, if the desired result is not obtained, grouting in the hole shall be discontinued when directed. In such event, the hole shall be cleaned, the grout allowed to set, and additional drilling and grouting shall then be done in this hole or in the adjacent area as directed, until the desired resistance is built up. After the grouting of any stage of a hole is finished, the pressure shall be maintained by means of a stop-cock or other suitable device until the grout has set to the extent that it will be retained in the hole. Grout that cannot be placed, for any reason, within two hours after mixing shall be wasted. If such grout is mixed at the direction of the Architect-Engineer, such wasted grout except as specified in paragraph "Measurement and Payment" will be paid for at the contract unit prices for the materials contained therein.

(3) Equipment arrangement and operation. The arrangement of the grouting equipment shall be such as to provide a continuous circulation of grout throughout the system and to permit accurate pressure control by operation of a valve on the grout return line, regardless of how small the grout take may be. The equipment and lines shall be prevented from becoming fouled by the constant circulation of grout and by the periodic flushing out of the system with water. Flushing shall be done with the grout intake valve closed, the water supply valve open, and the pump running at full speed.

d. Protection to work and cleanup: During grouting operations the Contractor shall take such precautions as may be necessary to prevent drill cuttings, equipment exhaust oil, wash water, and grout, from defacing or damaging the permanent structure. The Contractor will be required to furnish such pumps as may be necessary to care for waste water and grout from his operations. The Contractor shall, upon completion of his operations, clean up all waste resulting from his operations that is unsightly or would interfere with the efficient operation of the project as anticipated by the original design.

e. **Records:** The Architect-Engineer will keep records of all grouting operations, such as a log of the grout holes, results of washing and pressure testing operations, time of each change of grouting operation, pressure, rate of pumping, amount of cement for each change in water-cement ratio, and other data as deemed by him to be necessary. The Contractor shall furnish all necessary assistance and cooperation to this end.

7-07 MEASUREMENT AND PAYMENT:

a. General: The contract prices for the various items of work and materials shall constitute full compensation for mobilizing, demobilizing and furnishing all equipment necessary to perform the drilling and grouting of the structure in accordance with these specifications; all drilling, washing and pressure testing of grout holes; care and disposal of waste water and waste grout; clean-up of the site; furnishings, handling, transporting and storing of grout materials; and furnishing all labor and supplies incidental to the work. No payment will be made for grout, or the material constituents thereof, wasted due to improper anchorage of grout pipe or connections, or which is wasted due to negligence on the part of the Contractor, nor for grout which is rejected by the Architect-Engineer because of improper mixing. Payment will be made at the applicable contract unit prices for materials contained in grout which are wasted, where the wasting is not due to negligence on the part of the Contractor.

b. Mobilization and demobilization: The cost of assembling all plant and equipment at the site preparatory to initiating the work, and for removing it therefrom when the drilling and grouting program has been completed, will be made at the lump sum price bid for "Mobilization and Demobilization of Grouting Equipment".

c. Drilling grout holes: Drilling of grout holes will be measured for payment on the basis of the linear feet of holes actually drilled in rock or concrete as shown on the drawings or as directed, including all intermediate holes. Payment for drilling grout holes will be made at the unit price per linear foot bid for "Drilling Grout Holes".

d. Drilling exploratory holes: Drilling of exploratory holes will be measured for payment on the basis of the linear feet of holes actually drilled in rock or concrete, as directed by the Architect-Engineer. Payment for drilling exploratory holes will be made at the unit price per linear foot bid for "Drilling Exploratory Holes".

e. Drilling drain holes: Drilling of drain holes will be measured for payment on the basis of the linear feet of holes actually drilled in

concrete and rock as shown on the drawings or as directed. Payment for drilling drain holes will be made at the unit price per linear foot bid for "Drilling Drain Holes".

f. Grouting connections: Payment for connections to grout holes found necessary for the purpose of injecting grout, as determined necessary by the Architect-Engineer, will be paid for at the unit price per connection for "Grouting Connections". Payment for each such connection will be made, regardless of the amount of grout actually injected, at the established unit price per connection.

g. Foundation grouting: The operation of furnishing and placing grout will be measured for payment on the basis of the number of cubic feet of material, exclusive of water and regardless of the proportions of the mixes, satisfactorily placed. Payment for furnishing and placing grout in grout and exploratory holes will be made at the unit price per cubic foot bid for "Foundation Grouting", which price shall constitute full compensation for proportioning the mix as directed, and mixing and injecting the grout, all as specified herein or as may be directed.

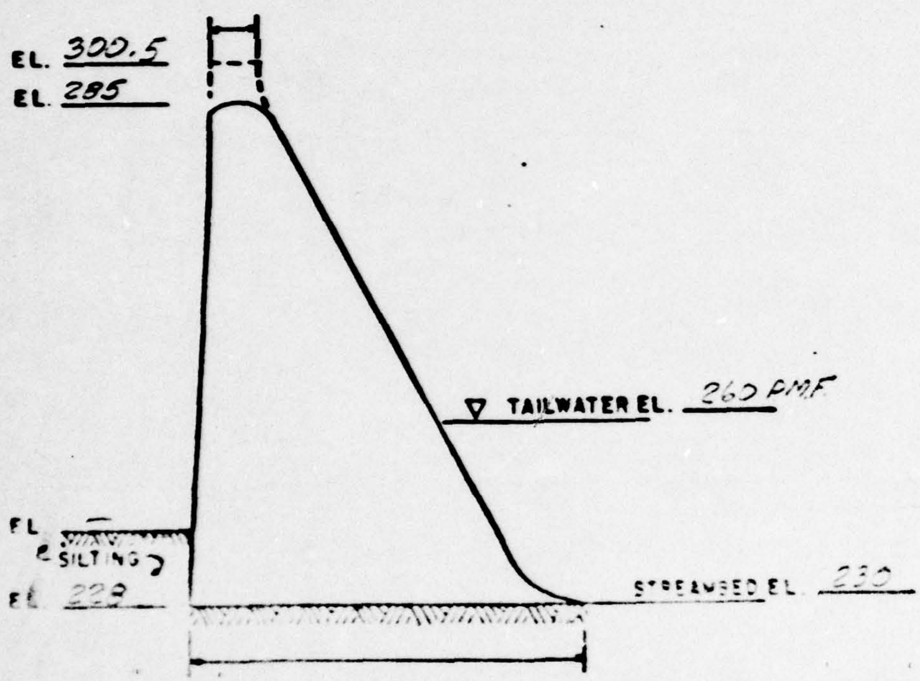
APPENDIX V

STABILITY ANALYSIS

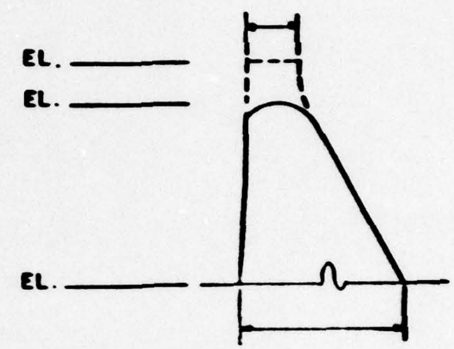
GRAVITY DAM DESIGN
STABILITY ANALYSIS

ANALYSIS DONE ON ✓ FULL SECTION ___ PARTIAL SECTION
LOCATION OF SECTION STA. 10+00 PRINCIPAL SPILLWAY BROAD RUN DAM
ANALYSIS PREPARED BY Edward H. Martin & Assoc., Inc. (Paul Seiler)

LOADING CASE	ELEV HEAD WATER	ELEV. TAIL WATER	ΣV	ΣH	$\frac{\Sigma H}{\Sigma V}$	LOCATION RESULTANT FROM TOE	% BASE IN COMPRESSION	FACTOR SAFETY SLIDING	FOUNDATION PRESSURE	
									TOE	HEEL
Water at TOP Princ. Spillway	285	–	188 k	101 k.	0.5	19.2'	100%	8.0	6.5 k/S.F.	0.1 k/S.F.
P.M.F.	320.5	260	125.7 k	124.7	0.99	3.1'	16.5%	6.06	26.7 k/S.F.	–



FULL SECTION



PARTIAL SECTION

BORING LOG

Location Manassas, Va. | Structure Dam | Comm. No. [illegible]
Geologist H.G. | Sheet 1 of 2 | Boring No. 3
Contractor C.C.D. | Engineer — | Date 2 Nov. 1965

Misc. Data	
Lnth of hole	50.0'
Rock	47.0
Wt of hammer	140"
Av fall of ham	30"
El of grd. water	232.4

Stratification: Elevation	Depth	Legend	Description of Materials (Type, color & Consistency)	Sampler or Spoon: Blows	Penetration	Sample No.	REMARKS
[illegible]8	0.0						
			Tan clayey SILT w/ fine to coarse SAND, PEBBLES, COBBLES & rock fragments				W.T. @ 0.4' - 24 Hrs. Alluvium
[illegible]8	3.0		TOP WEATHERED ROCK				CORE RECOVERY 2.5'-3.5'-70%
	5.0						CORE RECOVERY 3.5'-5.0'-73%
[illegible]8	10.0						CORE RECOVERY 5.0'-8.7'-94%
			Blue-gray fractured to highly fractured porphyritic QUARTZ DIORITE w/ slickensides on some fractures & some alteration along fractures				CORE RECOVERY 8.7'-11.4'-89%
	15.0						
[illegible]8	20.0						CORE RECOVERY 11.4'-18.0'-98%
	25.0						CORE RECOVERY 18.0'-25.5'-[illegible]%
[illegible]8	30.0						CORE RECOVERY 25.5'-30.0'-[illegible]%

BORING LOG

Location Monassas, Va. | Structure Dam | Comm. No. 3139A
Geologist H.G. | Sheet 2 of 2
Boring No. 3
Contractor C.C.D | Engineer — | Date 3 Nov. 1965

Elevation	Depth	Legend	Description of Materials (Type, color & Consistency)	Blows	Penetration	Sample No.	Remarks
202.8	30.0						
	35.0						
			Fractured to highly fractured porphyritic QUARTZ DIORITE				
			lw slickensides on some fractures				
192.8	40.0		and some alteration along fractures				CORE RECOVERY 30.0'-40.0'-99%
	45.0						CORE RECOVERY 40.0'-45.5-99+%
182.8	50.0						CORE RECOVERY 45.5'-50.0'-85% 0.3'-0.4' Core
			Bottom of Hole				left in hole.
							Hole Completed 12:30pm 3Nov.1965
							4.0'-3½" Flush Joint Casing

Misc. Data

Lnth of hole 50.0'

Rock 47.0'

Wt of hammer 140

Av fall of ham 30

El of grd. water 232

BORING LOG

Location Manassas, Va.
Contractor C.C.D
Structure Dam
Geologist H.G
Engineer —
Comm. No. 3139A
Sheet 1 **of** 2
Boring No. 4
Date 3 Nov. 1965

Misc. Data
- Lnth of hole 60.0'
- Rock 51.5'
- Wt of hammer 140#
- Av fall of ham 30"
- El of grd. water 239.7

Stratification: Elevation	Depth	Legend	Description of Materials (Type, color & Consistency)	Sampler or Spoon: Blows	Penetration	Sample No.	REMARKS
248.5	0.0						
247.6	0.9		TOPSOIL, ROOTS & ORGANICS				W.T. @ 8.8'-166 Hr
	5.0		Brown, sandy SILT /w some clay, many rock fragments & large blocks				
240.0	8.5		TOP WEATHERED ROCK				
238.5	10.0						CORE RECOVERY 8.5'-10.2'-71%
	15.0		Blue-gray, fractured porphyritic QUARTZ DIORITE /w slickensides on some fractures & some alteration along fractures				
228.5	20.0						CORE RECOVERY 10.2'-20.2'-99
							CORE RECOVERY 20.2'-22.2'-99
							CORE RECOVERY 22.2'-24.0'-95%
	25.0						
218.5	30.0						

BORING LOG

Location: Manassas, Va.
Structure: Dam
Geologist: H.G
Engineer: —
Contractor: C.C.D
Comm. No. 3133A
Sheet 2 of 2
Boring No. 4
Date 4 Nov. 1965

Elevation	Depth	Legend	Description of Materials (Type, color & Consistency)	Sampler or Spoon: Blows	Sampler or Spoon: Penetration	Sample No.	Misc. Data / REMARKS
							Lnth of hole 60.0'
							Rock 51.5'
							Wt of hammer 140#
							Av fall of ham 30"
							El of grd. water 239.7
218.5	30.0						
							CORE RECOVERY 24.0'-31.5'-96%
	35.0						
[illegible]08.5	40.0		Blue-gray, fractured porphyritic QUARTZ DIORITE w/ slickensides along some fractures & some alteration along fractures				
							CORE RECOVERY 31.5'-41.0'-99+%
	45.0						
[illegible]8.5	50.0						
							CORE RECOVERY 41.0'-51.2'-99+%
	55.0						
							9.0'-3½" Flush Joint Casing
[illegible]8.5	60.0						CORE RECOVERY 51.2'-60.0'-99+%
			Bottom of Hole				Hole Completed 5:00 pm 4 Nov. 1965

BORING LOG

Location *Manassas, Va.*　　Structure *Dam*　　Comm. No. *3137A*

Geologist *H.G*　　Sheet *1* of *3*

Contractor *C.C.D*　　Engineer *—*　　Boring No. *13*

Date *28 Nov. 1966*

Misc. Data	
Lnth of hole	90.0'
Rock	88.1'
Wt of hammer	140"
Av fall of ham	30"
El of grd. water	—

Stratification: Elevation	Depth	Legend	Description of Materials (Type, color & Consistency)	Sampler or Spoon: Blows	Penetration	Sample No.	REMARKS
251.1	0.0						
249.2	1.9		Topsoil, leaves, twigs & roots /w small rock fragments.				W.T. @ 9.0' 6 Jan. 6[illegible]
						1.6	CORE RECOVERY 1.7'-3.5'-89%
	5.0					1.6'	CORE RECOVERY 3.5'-5.0'-99+%
							Noticed drill Wat[illegible] issuing from fractures @ Crea[illegible]
241.1	10.0						level - Elev. 25[illegible].0 Lost Wash Water @ 8.0'
			Blue-gray fractured QUARTZ DIORITE /W Serpentine along fractures			4.6'	CORE RECOVERY 5.0'-10.0'-92%
	15.0					6.6	CORE RECOVERY 10.0'-16.5'-99+%
231.1	20.0						
	25.0					10.1	CORE RECOVERY 16.5'-26.5'-99+%
221.1	30.0						Porphyritic 28.[illegible] -29.5'- phenocrys[illegible] ts up to 1" long.

BORING LOG

Location: Manassas, Va.
Contractor: C.C.D

Structure: Dam
Geologist: H.G
Engineer: —

Comm. No. 3137A
Sheet 2 of 3
Boring No. 13
Date 29 Nov. 1966

Misc. Data

Lnth of hole	90.0'
Rock	88.1'
Wt of hammer	140 #
Av fall of ham	30"
El of grd. water	—

Stratification: Elevation	Stratification: Depth	Stratification: Legend	Description of Materials (Type, color & Consistency)	Sampler or Spoon: Blows	Sampler or Spoon: Penetration	Sample No.	REMARKS
221.1	30.0						
	35.0					10.0	CORE RECOVERY 26.5'-36.5'-99%
211.1	40.0		Blue-gray fractured QUARTZ DIORITE / W serpentine along fractures				
	45.0					9.9	CORE RECOVERY 36.5'-46.5'-99%
201.1	50.0						
	55.0					9.9	CORE RECOVERY 46.5'-56.5'-99%
191.1	60.0						

BORING LOG

Location: Manassas, Va.	Structure: Dam	Comm. No. 3139A	
	Geologist: H.G	Sheet 3 of 3	
Contractor: C.C.D	Engineer: —	Boring No. 13	
		Date 30 Nov. 1966	

Misc. Data

- Lnth of hole: 90.0'
- Rock: 88.1'
- Wt of hammer: 140#
- Av fall of ham: 30"
- El of grd. water: —

Stratification: Elevation	Depth	Legend	Description of Materials (Type, color & Consistency)	Sampler or Spoon: Blows	Penetration	Sample No.	REMARKS
311	60.0						
							Highly fractured 62.0' to 66.5'
	65.0					9.9'	CORE RECOVERY
							56.5'-66.5'-99%
31.1	70.0		Blue-gray fractured				
			QUARTZ DIORITE W/ Serpentine along fractures			5.0'	CORE RECOVERY 66.5'-71.5'-99%
	75.0						
11.1	80.0						
						9.8'	CORE RECOVERY 71.5'-81.5'-98%
	85.0						1.9'-3½" Flush Joint Casing
			Core barrel blocked Highly fractured 83.0'-90.0'			7.0'	CORE RECOVERY 81.5'-88.5'-99%
.1.1	90.0					1.4'	CORE RECOVERY 88.5'-90.0'-99%
			Bottom of Hole				Hole Completed 11:00am 1 Dec. 1966

BORING LOG

Location: Manassas, Va.
Structure: Dam
Geologist: H.G
Engineer: —
Contractor: C.C.D
Comm. No. 3139A
Sheet 1 of 2
Boring No. 14
Date 25 Nov. 1966

Misc. Data
- Lnth of hole: 50.1'
- Rock: 44.7'
- Wt of hammer: 140#
- Av fall of ham: 30"
- El of grd. water: 233.4

Stratification: Elevation	Depth	Legend	Description of Materials (Type, color & Consistency)	Sampler or Spoon: Blows	Penetration	Sample No.	Remarks
236.1	0.0						
235.1	1.0		TOPSOIL & ROOTMAT				W.T. @ 2.7'-6 Jan. 67
			Brown SILT w/ roots, pieces of wood & rock fragments.	10	1"		SAMPLE 1.5'-2.5' Drove sample between two (2) rocks
	5.0						
230.7	5.4		TOP BEDROCK				
							Highly fractured 8.4'-9.5'
226.1	10.0						CORE RECOVERY 5.4'-10.5'-94%
			Blue-gray fractured QUARTZ DIORITE w/ serpentine along fractures & slickensides				
	15.0		Quartz vein-0.08' thick @ 15.8'				
216.1	20.0						CORE RECOVERY 10.5'-20.5'-99%
	25.0						
206.1	30.0						CORE RECOVERY 20.5'-30.5'-99%

BORING LOG

Location Manassas, Va.

Contractor C.C.D

Structure Dam

Geologist H.G

Engineer —

Comm. No 3139A

Sheet 2 of 2

Boring No. 14

Date 25 Nov. 1966

Misc. Data	
Lnth of hole	50.1'
Rock	44.7
Wt of hammer	140#
Av fall of ham	30"
El of grd. water	233.4

Elevation	Depth	Legend	Description of Materials (Type, color & Consistency)	Sampler or Spoon: Blows	Sampler or Spoon: Penetration	Sample No.	REMARKS
[illegible].1	30.0						
	35.0						CORE RECOVERY 30.5'-35.5-99%
[illegible].1	40.0		Blue-gray fractured QUARTZ DIORITE/W Serpentine along fractures				Highly fractured 41.0'-44.0'
							CORE RECOVERY 35.5'-44.0'-99%
	45.0						
[illegible].1	50.0						
[illegible].0	50.1		Bottom of Hole				CORE RECOVERY 44.0'-50.1'-99%
							Hole Completed 12:00 Noon 28 Nov. 1966
							6.0'-3½" Flush Joint Casing

BORING LOG

Location Manassas, Va. | Structure Dam | Comm. No. 3139A
Geologist H.G | Sheet 1 of 2 | Boring No. 15
Contractor C.C.D | Engineer — | Date 1 Dec. 1966

Elevation	Depth	Legend	Description of Materials (Type, color & Consistency)	Sampler or Spoon: Blows	Penetration	Sample No.	Misc. Data / REMARKS
							Lnth of hole 50.3'
							Rock 38.3'
							Wt of hammer 140#
							Av fall of ham 30"
							El of grd. water 238.4
240.1	0.0						
			TOPSOIL, ROOTS & LEAVES				W.T. c 1.7'-6 Jan 67
238.6	1.5			10	1'	1	SAMPLE 1.5'-2.5'
			Brown SILT w/ few small rock fragments & roots - trace of Sand & occasional Cobble (ALLUVIAL)				
	5.0			40	1'	2	SAMPLE 5.0'-6.0'
230.1	10.0		Increase in Cobbles quartzite & diorite c 11.0'	66	1'	3	SAMPLE 10.0'-11.0' Mostly Wash
228.1	12.0		TOP ROCK				
	15.0						
220.1	20.0		Blue-gray fractured QUARTZ DIORITE w/ Serpentine along fractures w/ Some Slickensides along fractures.				CORE RECOVERY 12.0'-22.0'-99%
							Highly fractured 22.0'-24.0'
	25.0						
210.1	30.0						

BORING LOG

Location Manassas, Va. **Structure** Dam **Comm. No** 3139A

Geologist H.G **Sheet** 2 **of** 2

Contractor C.C.D **Engineer** — **Boring No.** 15

Date 2 Dec. 1966

Misc. Data	
Lnth of hole	50.3'
Rock	38.3'
Wt of hammer	140#
Av fall of ham	30"
El of grd. water	238.9

Stratification: Elevation	Depth	Legend	Description of Materials (Type, color & Consistency)	Sampler or Spoon: Blows	Penetration	Sample No.	REMARKS
210.1	30.0						
							CORE RECOVERY 22.0'-32.0'-99%
	35.0						
200.1	40.0		Blue-gray fractured QUARTZ DIORITE w/ Serpentine along fractures				CORE RECOVERY 32.0'-42.0'-[illegible]
	45.0						
190.1	50.0						CORE RECOVERY 42.0'-50.3'-97%
189.8	50.3		Bottom of Hole				
							Hole Completed 11:30am 2 Dec. 1966
							12.0'-3½" Flush Joint Casing

BORING LOG

Location Manassas, Va **Structure** Dam **Comm. No.** 3139A
Geologist H.G **Sheet** 1 **of** 3
Contractor C.C.D **Engineer** — **Boring No.** 16
Date 28 Nov. 1966

Stratification			Description of Materials (Type, color & Consistency)	Sampler or Spoon		Sample No.	Misc. Data
Elevation	Depth	Legend		Blows	Penetration		Lnth of hole 83.1' Rock 72.1' Wt of hammer 140# Av fall of ham 30" El of grd. water — REMARKS
241.8	0.0						
241.2	0.6		TOPSOIL, ROOTS & LEAVES				W.T. c 0.7' - 6 Jan. 67
			Brown clayey SILT w/ small rock fragments & occasional roots	10	1'		SAMPLE 1.5'-2.5'
236.8	5.0						
			Mixed COLLUVIUM & ALLUVIUM including cobble size pieces of quartz diorite, vein quartz, greenstone & quartzite in a silt-clay matrix				
231.8	10.0						
230.8	11.0		TOP BEDROCK				
							CORE RECOVERY 11.0'-14.2'-97%
	15.0						
			Blue-gray fractured QUARTZ DIORITE w/ serpentine along fractures & slickensides				
221.8	20.0						Highly fractured - 20.0'-21.5'
							CORE RECOVERY 14.2'-24.2'-99+%
	25.0						
211.8	30.0						

BORING LOG

Location Manassas, Va.
Contractor C.G.D
Structure Dam
Geologist H.G
Engineer —
Comm. No. 3132A
Sheet 2 of 3
Boring No. 16
Date 29 Nov 1966

Misc. Data	
Lnth of hole	83.1'
Rock	72.1'
Wt of hammer	140#
Av fall of ham	30"
El of grd. water	—

Stratification: Elevation	Depth	Legend	Description of Materials (Type, color & Consistency)	Sampler or Spoon: Blows	Penetration	Sample No.	REMARKS
211.8	30.0						
	35.0						CORE RECOVERY 24.2'-34.2'-96%
201.8	40.0		Blue-gray fractured QUARTZ DIORITE w/ serpentine along fractures				CORE RECOVERY 34.2'-42.9'-99%
	45.0						
191.8	50.0						CORE RECOVERY 42.9'-52.9'-99%
	55.0						
181.8	60.0						

BORING LOG

Location *Manassas, Va.* | Structure *Dam* | Comm. No. *3139A*

Contractor *C.C.D* | Geologist *H.G* | Sheet *3* of *3*

Engineer *—* | Boring No. *16*

Date *30 Nov. 1966*

Stratification: Elevation	Depth	Legend	Description of Materials (Type, color & Consistency)	Sampler or Spoon: Blows	Penetration	Sample No.	Misc. Data: Lnth of hole *83.1'*; Rock *72.1'*; Wt of hammer *140#*; Av fall of ham *30"*; El of grd. water; REMARKS
131.8	60.0						
							CORE RECOVERY 52.9'-63.1'-99%
	65.0						
121.8	70.0		Blue-gray fractured				Highly altered 69.8' to 70.1'
			QUARTZ DIORITE W/ Serpentine along fractures.				CORE RECOVERY 63.1'-73.1'-96%
							Highly fractured 72.8' to 74.5'
	75.0						
111.8	80.0						
							CORE RECOVERY 73.1'-83.1'-99%
108.7	83.1		Bottom of Hole				
							Hole Completed 3:30pm 30 Nov. 1966
							12.5'-3½" Flush Joint Casing

BORING LOG

Location Manassas, Va **Structure** Dam **Comm. No.** 3139A

Geologist H.G **Sheet** 1 **of** 2

Contractor C.C.D **Engineer** — **Boring No.** 17

Date 25 Nov. 1966

Stratification: Elevation	Stratification: Depth	Stratification: Legend	Description of Materials (Type, color & Consistency)	Sampler or Spoon: Blows	Sampler or Spoon: Penetration	Sample No.	Misc. Data / REMARKS
							Lnth of hole 49.4'
							Rock 35.9'
							Wt of hammer 140#
							Av fall of ham. 30"
							El of grd. water 241.1
244.8	0.0						
244.3	0.5		TOPSOIL & ROOTMAT				W.T. @ 3.7'-6 Jan.67
			Quartz diorita, COLLUVIUM/W silt & clay between blocks				
	5.0						
234.8	10.0						
231.3	13.5		TOP BEDROCK				Highly fractured-13.5'-15.0'
	15.0						
							CORE RECOVERY 13.5'-17.7'-93%
224.8	20.0		Blue-gray fractured QUARTZ DIORITE/W serpentine along fractures.				
	25.0						
							CORE RECOVERY 17.7'-27.7'-96%
214.8	30.0						Highly fractured 28.2'-30.2'

BORING LOG

Location *Manassas, Va* Structure *Dam* Comm. No *3139A*

Geologist *H.G* Sheet *2* of *2*

Contractor *C.C.D* Engineer — Boring No. *17*

Date *25 Nov. 1966*

Elevation	Depth	Legend	Description of Materials (Type, color & Consistency)	Sampler or Spoon: Blows	Sampler or Spoon: Penetration	Sample No.	Misc. Data / REMARKS
							Lnth of hole [illegible]
							Rock [illegible]
							Wt of hammer 140#
							Av fall of ham 30"
							El of grd. water 241.1
[illegible].8	30.0						
							CORE RECOVERY 27.7'-31.7'-95%
	35.0						
[illegible]4.8	40.0		Blue-gray fractured QUARTZ DIORITE /W Serpentine along fractures				CORE RECOVERY 31.7'-39.2'-92%
	45.0						
[illegible]5.4	49.4		Bottom of Hole				CORE RECOVERY 39.2'-49.4'-99%
							Hole Completed
							10:00 am 28 Nov. 1966
							13.5'-3½ Flush Joint Casing

APPENDIX VI

FIELD OBSERVATIONS

Incl. 3

Lake Manassas Ref. Inv. Dams Pg 714 Report 1/12/74 VA 15302 NAD VA 153-08

Check List
Visual Inspection
Phase 1

STREAM: Broad Run
H. CREST: 1185
DISCH: 50,000 cfs
OWNER: MANASSAS

ENG. BY: Hayes, Seay, Mattern & Matte
CONSTRUCTED BY: Jackson
QUAD: Gainsville & Thoroughfare Gap

Name Dam Broad Run Dam County Prince William State Virginia Coordinators Lat. 3845.8
Long. 7737.3

Date(s) Inspection 12/6/78 Weather clear Temperature 60°

Pool Elevation at Time of Inspection 285 Tailwater at Time of Inspection 234

Inspection Personnel:

Forest Fister, DMM&A, Hydrology
John S. Jones, Law Engineering, Geo. & Soils
Bill Swartz, Manassas Water Treatment Plant
Tim Perry, SWCB, Regional Office
Wade Whetzel, Manassas Water Treatment Plant
Don Echols, Manassas Water Works Dept.

Paul Seiler, DMM&A, Civil Engr. Recorder

CONCRETE/MASONRY DAMS

ISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
EE PAGE ON LEAKAGE	None visible through spillway. Wet area on wall at right abutment, halfway down steps to Passageway.	
TRUCTURE TO BUTMENT/EMBANKMENT JUNCTIONS	No visible seepage at junction of wall and embankment right abutment and left abutment.	
RAINS	None visible.	
ATER PASSAGES	See note on walkway passage-gallery.	
OUNDATION	Not visible. No crack in spillway structure.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBERSVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Hairline crack 5' vertical approximately 10' left of left end of spillway in concrete wall shows white deposits.	
STRUCTURAL CRACKING	None visible.	
VERTICAL AND HORIZONTAL ALIGNMENT	Horiaontal ok. Owner representative reported that water goes over crest of principal spillway at right end of spillway before covering the entire length of spillway crest. See Photo No. 2. This could indicate settlement at left end of spillway, or crest was not level when constructed.	
MONOLITH JOINTS	No visible seepage.	
CONSTRUCTION JOINTS	44 ft. right from left end of spillway, about 5 feet below crest, was wet for a length of 60 feet and showed calcium deposits. Owner reported this was happening for several years. The water enters at a horizontal construction joint on the downstream side of passageway.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None visible.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	No visible movement of toe, cracks or seepage.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None visible.	
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	O.K.	
RIPRAP FAILURES	None Riprap lake side is 18 feet up side of embankment.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	No Crack.	
ANY NOTICEABLE SEEPAGE	No visible seepage.	
STAFF GAGE AND RECORDER	None at dam. Waterworks reads downstream gage to maintain minimum required discharge for downstream use.	
DRAINS	None visible	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None visible.	
INTAKE STRUCTURE	Not visible.	
OUTLET STRUCTURE	Concrete spillway Ogee type (See ungated.) Lake drain pipe - valve controlled - by waterworks. (48" diameter). Discharging at time of inspection, pipe cast in concrete of dam.	
OUTLET CHANNEL	Rock debris in channel from bridge pier protection, bridge is located about 200 feet downstream from dam. Channel downstream from debris is clear, has earth banks 4 to 5 feet high. 1,000 feet downstream from dam, near back filter lagoon, there was a wet spot about 100 feet to the right from the channel. 1,200 feet downstream from dam there is a wet spot in field about 200 feet right from channel.	- appears to be from water treatment plant lagoon. - appears to be from drain field.

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Ogee principal spillway.	
APPROACH CHANNEL	Not visible.	
DISCHARGE CHANNEL	Concrete spillway, ogee type to riprap channel. See outlet works outlet channel.	
BRIDGE AND PIERS	3-span 2-lane structure 200' downstream from dam. With stood 1972 flood. Washed rip-rap away from bridge piers. No bridge over principal spillway.	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	No visible cracks.	
APPROACH CHANNEL	Forested.	
DISCHARGE CHANNEL	See outlet channel outlet works.	
BRIDGE AND PIERS	None.	
GATES AND OPERATION EQUIPMENT	Valves are operational and used by water works personnel each day. Operation is manual to select each of 5 levels to draw down water from lake. There is a valve in the plant to control flow of water into plant. Discharge to downstream is by manual control.	

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER		

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Steep to moderate slopes to shoreline. 75% pasture land, stable shoreline, wave action 8" to 18".	
SEDIMENTATION	No information available.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

EM	REMARKS
AN OF DAM	
GIONAL VICINITY MAP	
NSTRUCTION HISTORY	
PICAL SECTIONS OF DAM	See plans.
YDROLOGIC/HYDRAULIC DATA	See plans.
JTLETS - PLAN	
- DETAILS	
-CONSTRAINTS	
-DISCHARGE RATINGS	
INFALL/RESERVOIR RECORDS	None at reservoir.

/ncs

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Bridge 200-300 ft. below dam. Channel has riprap washed from bridge piers.	
SLOPES	Narrow channel at bridge 150' wide, 4-6' deep. Wide flood plains.	
APPROXIMATE NO. OF HOMES AND POPULATION	Water Treatment Plant 400' downstream, approximately 7 farm homes in 1,200 ft. below dam. Manassas airport approximately 9 miles downstream.	

'EM	REMARKS
ESIGN REPORTS	Water supply study City of Manassas, Va. Bid specs in owner files. Design plans on file with owner.
EOLOGY REPORTS	See bid Specs on file with owner, for borings.
ESIGN COMPUTATIONS	Not on file with Owner.
YDROLOGY & HYDRAULICS	
AM STABILITY	
EEPAGE STUDIES	None to date.
MATERIALS INVESTIGATIONS	
ORING RECORDS	
ABORATORY	
IELD	See bid specs.
OST-CONSTRUCTION SURVEYS OF DAM	None taken.
ORROW SOURCES.	None known.

ITEM	REMARKS
PILLWAY PLAN	
SECTIONS	See plans.
DETAILS	
PERATING EQUIPMENT LANS & DETAILS	

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	None.
HIGH POOL RECORDS	None.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None.
MAINTENANCE OPERATION RECORDS	No existing system, water employees daily are on dam because of valves to treatment plant. Their observations not logged.

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Wooded/Argicultural , 60 sq. mi.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 285 12000 Ac. ft.

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): Same as above

ELEVATION MAXIMUM DESIGN POOL: Elev. 302

ELEVATION TOP DAM: Elev. 302

CREST: Principle spillway

a. Elevation 285 feet
b. Type O-gee
c. Width 220 feet
d. Length
e. Location Spillover North of mid-point of Dam
f. Number and Type of Gates None.

OUTLET WORKS:

a. Type Valved pipe.
b. Location South end of Spillway.
c. Entrance inverts
d. Exit inverts
e. Emergency draindown facilities 48" pipe.

HYDROMETEOROLOGICAL GAGES:
a. Type
b. Location
c. Records

MAXIMUM NON-DAMAGING DISCHARGE: 53038 cfs.

APPENDIX VII

REFERENCES

REFERENCES

Reference No. 1: Riedel, J.T.; Appleby, J.F.; and Schloemer, R.W.; Hydrometeorological Report No. 33, "Seasonal Variation of the Probable Maximum Precipitation East of the 105th Meridian for Areas from 10 to 200 to 100 Square Miles and Durations of 6, 12, 24, and 48 hours"; U.S. Department of Commerce, Weather Bureau, Hydrologic Services Division, 1956.

Reference No. 2: Synder, "F.F. Synthetic Unit-graphs", Transactions of the American Geophys. Union, Vol. 19, pp 497-545, 1938.

BROAD RUN DAM

List of Data Available

Furnished by:

Town of Manassas, Virginia

1. Report of Water Supply Study of 1966.

2. Plans - Broad Run Dam and Impoundment, Town of Manassas, prepared by Hayes, Seay, Mattern & Mattern, Roanoke, Virginia.

3. Specifications - Contract documents for Broad Run Dam.

4. Hydrologic and Hydraulic Data - Optimization of Raw Water Interconnections, Washington D.C. area for the Corps of Engineers, Norfolk, Prepared by GKY & Associates, Inc., Alexandria, Virginia.